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The Manhattan Elevated R. R. Co., according to the decision of Judge Ingraham, of the Supreme Court, will be permitted to continue the work of laying "sidings and switches" on the Ninth Avenue line, between 17th and 23d Streets, New York city. The city's application for an injunction is refused upon the ground that the commission appointed under the act of 1875, and which commission approved this work, is a continuous body; not affected by the act of 1890 appointing the Rapid Transit Commission, and had full authority to grant the permit. Judge Ingraham confined his decision, however, to the piece of track now under construction, and he scored the Manhattan company for seeking legal authority for this work only after the suit against it had been commenced.

Traffic on the Manchester Canal was brisk in the week ending Jan. 23, says the "Transport." The arrivals numbered 24 ships, three of them cotton ships, with 9,000 tons of cargo in all. Twenty-three vessels and 3,000 tons of cargo departed in the same time. One vessel collided with the pierhead at Latchford Locks and was damaged about her bows. This same ship, the "Venango," took 9h. 25m. to make the 35½-mile trip up the canal. According to "Transport" almost every ship of any size so far passing through the canal has sustained some injury to her plates, or has inflicted some damage to the canal banks.

An arch of Portland cement concrete of unusual dimensions has recently been built over the River Danube at Munderkingen, Wurttemberg. It has a span of 164 ft. and a rise of 1-10 or 16.4 ft. One abutment is formed by the natural rock, while the other is composed of 145 piles driven obliquely. The width of the arch is 24 ft. 3 ins., and the clearance between railings 26 ft. 3 ins. Transverse arches having a span of 8 ft. are built through the spandrel walls, beyond which they project 32 ins., and in order to diminish the dead load, no spandrel filling has been used. As the pressure on the concrete of the arch allowed for is 425 lbs. per sq. in. special joints are used at the haunches and the apex to counteract any evil effects of the settling of the arch. The apex settled 2¾ ins., when the centers were struck, and 1⅝ ins. more when the roadbed was put on. The bridge is given an architectural ornamentation in red cement. The cost of the bridge was $11,800.

The 75-ft. headway provided under the fixed bridges over the Manchester Canal is giving trouble to vessels leaving Manchester without cargo sufficient to immerse them to the load line with which they came up the canal. This return cargo is said to be difficult to obtain, and the 10-ft. difference between heavy and light draft presents a troublesome problem to overcome. The soft sandstone rock forming the banks of the canal for some miles has been slipping under the influence of frost, and complaints are made of difficulties in navigation, caused by insufficient depth of water at some places, the lack of sufficient lights at night and the lack of sufficient headway under bridges, as above stated.

Another bridge across the Mississippi at St. Louis is proposed by the East St. Louis and St. Louis Bridge & Construction Co., which now has a bill before Congress asking for authority. Little is said about the plans as yet, though it seems to be intended as a railway and toll-bridge.

Small electric motors are to be tried for sewer ventilation in an English town. A continuous supply of current is to be furnished by the local electric lighting company at $100 per year per motor.

The New York Rapid Transit Commission seems to have definitely dropped the consideration of the Wilson underground scheme, and is now hard at work developing the Bushe elevated railway project for rapid transit. The John H. Davis & Co. syndicate is said to have withdrawn its proposition to build an underground road with private capital. Any elevated system using the street surface will be very unpopular; but it will be interesting to watch the movements of the Manhattan company and the promoters of the new East River bridge in connection with this Bushe deal.

A 182-ft. plate girder swing bridge is being built for the Washington & Chesapeake Beach R. R. by the Youngstown Bridge Co., of Youngstown, O. This is, we believe, the longest plate girder span ever erected in this country, and was designed by Mr. C. E. Fowler, Chief Engineer of the company. We hope to give full details of the structure in a future issue.

The most serious railway accident of the week was a head collision of freight trains Feb. 12 near Bellevue, O., on the Wheeling & Lake Erie R. R. The eastbound train was running behind a passenger train, but owing to a snowstorm the crew of the westbound train did not see the signals displayed by the passenger train. Four men were killed.—Train wreckers removed the splice bars, bolts and spikes on a trestle carrying the Missouri, Kansas & Texas Ry. across White Oak bayou, near Houston, Tex. A passenger train was derailed, the engine and one car crossing in safety, while the mail car, baggage car and one passenger car went down. Four persons were seriously injured, and the flagman sent back was shot by the wreckers.

A wooden highway bridge at Hopewell Hill, New Brunswick, gave way under a wagon and team Feb. 9. The structure was 100 ft. long.

The flywheel at the Spartan mill, Spartanburg, S. C., broke Feb. 6, while running about half speed, and the engineman was killed and two assistants were injured. The wheel was 24 ft. diameter.

Three fires started by incendiaries on Feb. 7 did considerable damage to the Agricultural Building of the World's Columbian Exposition.

A portion of the structure of the Chicago & South Side Elevated Ry. settled about 3 ft. on Feb. 6. The place was at Hubbard Court, where one of the column foundations was undermined by an excavation for the foundations of a new building. A timber staying had been built to relieve this column of weight, but the timbers gave way as a heavily loaded northbound train and a lightly loaded southbound train were passing, and the weight coming on the column sank it two or three feet. The engineman of each train stopped his train as he felt the track sink. The passengers had to get out and walk.

The first steel sailing vessel built in New England is about to be launched at Bath, Me. The length of this ship is 311 ft.; beam, 45½ ft.; depth, 25½ ft.; gross tonnage, 3,005; net tonnage, 2,856. She is rigged as a four-masted schooner.

The cost of crushing stone at New Bedford, Mass., in 1893, according to the report of the Superintendent of Streets, was 30.51 cts. per ton for 16,472 tons of stone crushed in a stationary crusher and 42.29 cts. per ton for 6,241 tons of stone crushed in a portable crusher.

A resolution is before the Ohio Legislature proposing to introduce electric traction on the Ohio State canals, with the hope of thus making this property profitable. According to Representative Harshberger, who introduces the bill, the 688 miles of canals cost the state originally $14,340,572, and the Board of Public Works is now asking for an appropriation of $276,202 for use on these canals in 1894. This sum is $162,368 in excess of the gross receipts from all the canals of the state for 1892, and $179,689 more than the gross receipts in 1893. The bill recommends the appointment of a committee of 5 members of the House to ascertain the condition of the canals at present; the needed improvements and the approximate cost per mile of equipping the waterways with electric plant of sufficient power to propel canal boats. This committee is also to report upon the possibility and advisability of making these improvements, and to obtain the estimated value of the canals for electric and steam railway purposes.

In the article on Shop and Mill Construction, published in our issue of Jan. 25, 1894, we omitted to state that the designer and patentee of this type of construction was Mr. W. E. Stearns, of the Berlin Bridge Co. Several points of advantage are claimed for this construction over the usual type of construction for this class of buildings.

The harbor at Cape Town, South Africa, is being improved by the construction of iron jetties or piers at right angles to the breakwater, giving 30 ft. of water for vessels lying alongside. The first of these has recently been completed and is 600 ft. long and 70 ft. wide. There are about 200 iron screw piles, weighing about eight tons each, and driven through 15 ft. of sand to solid rock. The work was designed by Coode, Son & Matthews, of England, and Mr. H. Thwaites was resident engineer for the Harbor Board.

The Philadelphia fire-boat "Edwin S. Stuart" carries two Clapp & Jones double-acting pumps capable of delivering 9,000 gallons of water per minute. This stream can be directed through one 4½ in. nozzle to a horizontal distance of 490 ft., or it can be divided between eight 3½ in. nozzles, or sixteen 2½ in. nozzles. The capacity of the fire-boat is equal to that of eleven fire engines.

The financial outcome of the Chicago World's Fair is a probable dividend of 10 cts. on the dollar, to the city of Chicago, which contributed $5,000,000, and to the general stockholders. Auditor Barrington figures the disbursements of the Exposition proper at $26,746,420, up to Jan. 12, 1894, and the net assets, at $1,293,707. The capital stock, including Chicago's $5,000,000, amounts to $10,606,495. Some further expenditure necessary will reduce the dividend to the figure given.

The street railways of Massachusetts are dealt with in the second part of the report of the Board of Railroad Commissioners. The total length at the end of September, 1893, was 874.14 miles, an increase of 119.29 miles over the preceding year. This includes double track, but not 63.154 miles of sidings, switches, etc. Of this total there were 711.08 miles operated in whole or in part by electricity, and 163.06 miles by horse power, showing an increase during the year of 214.78 miles for the former and a decrease of 95.49 miles for the latter. All the electric roads have the overhead wire except the Milford & Hopedale line, which uses the storage battery. The report states that it is yet too early to draw exact and final conclusions as to the comparative financial economy of electricity and horse power, but that a comparison of the increase of net earnings with the increase in cost of railway per mile shows that there has thus far been no demonstration of superior net earning capacity of electric lines, but rather the reverse. It is stated that the popular idea that an electric railway is a bonanza of wealth is clearly a delusion, and that the safe policy for the companies is to keep the capitalization and charges upon income within the narrowest possible limits and to set aside annually a portion of the earnings for a contingency fund. Some of the principal statistical items presented in the report are given in the following table:

Passengers	213,552,000
Car miles	34,507,282
Round trips	4,481,171
Passengers per round trip	48
Ratio of oper. exp. to gross income	60.26%
Total income	$10,897,704
Total expenditures	10,617,942
Net income	276,762
Net earnings per mile	3,810
" " per round trip	74 cts.
" " per car-mile	9.65 "
" " per passenger	1.56 "
Passengers injured (2 fatally)	311
Employees injured (5 fatally)	48
Persons on street injured (38 fatally)	226

The U. S. Geological Survey, says the annual report of Director John W. Powell, has, during 1893, carried on topographical surveys in 28 states and territories, covering an area of about 26,000 sq. miles, at a cost of $423,022, or less than $20 per square mile. Since its organization this department has surveyed an area of 573,000 sq. miles, in 47 states and territories. The hydrographic force has been tabulating statistics as to the value of running streams, and roughly foots up this value at $600,000,000. But the meager advance reports at hand do not state what area this valuation covers.

NOTES FROM CITY ENGINEERS' AND OTHER MUNICIPAL REPORTS.

The report of Mr. Wm. Jackson, M. Am. Soc. C. E., City Engineer of Boston, contains the detailed results of an inspection to determine the causes of pollution of the Charles River, accompanied by a large map, and a study for a tunnel to connect East Boston with the city proper.

The various laws and ordinances concerning the building of sewers in Boston and assessments for the cost of the same passed from 1797 to 1892 are reprinted in the report for 1892 of Mr. H. H. Carter, Superintendent of Streets. Under the ordinance of 1892 the cost of all sewers up to $4 per lin. ft. is assessed on abutting property according to frontage.

The usual elaborate meteorological tables published in the report of the city engineer of Providence are continued this year. The report contains a number of illustrations, from photographs and line drawings, relating to the improved sewerage system now under construction and also illustrations of the same character showing improvements in connection with the new terminal facilities. Mr. J. Herbert Shedd is city engineer.

The city of Brooklyn has about 600 miles of streets, of which some 200 miles are neither graded nor paved. Of the 397 miles of paved streets 268 miles have cobble, 31 miles belgian, 85 miles granite and 13 miles concrete pavements. During 1892 there were cleaned 16,784 miles of streets at a total cost of $381,829, or an average of about $22.75 per mile. The cost of removing ashes was $147,000 for the year, making the cost of street cleaning and removal of ashes $529,000.

The range of prices for street and sewer work done at Passaic, N. J., in the years 1890, 1891 and 1892, is given in Table I. Colin R. Wise is city surveyor.

TABLE I.—Range of Prices for Street and Sewer Work in Passaic, N. J., in 1890, 1891 and 1892.

	1890.	1891.	1892.
Street Improvements.			
Earth excav., cu. yd	$ .28- .21	$ .30- .20	$ .30- .18
Rock " "	.55- .55	1.50- .77	.77- .40
20-in. bluestone curb and cobble gutter, lin. ft.	.60- .45	.64- .60	.55- .48
20-in. bluestone curb, lin. ft.	.45- .45	.48- .40	.40- .25
Cobble gutter alone, sq. ft.	.07- .06	.13- .06	.01- 03
Bluestone flagg'g, sq. ft.	.15- .15	.14	.14¼- 13½
Crosswalk, lin. ft	1.20	1.25-1.00	.90- .80
Sewer Work.			
3¼ × 4 ft. 10½-in. brick, lin. ft.	5.20-5.00	5.20-5.00	.....
2⅝ × 4 ft. brick, lin. ft.	4.50-3 50	4.50-4.00	.....
24 in. vitrifi'd pipe, lin. ft.	.....	.....	2.00-1.87
20-in. " " "	1.42	1.80-1.35	1.80-1.80
18-in. " " "	1.21	1.70-1.20	2.00-1.43
15-in. " " "	.82	1.35- .79	.....
12-in. " " "	.71	1.25- .65	.75- .75
10-in. " " "	.59	.70- .55	.55- .55
8-in. " " "	.49	.46- .40	.68- .43
6-in. " " "	.41	.40- .25	.25- .25
Rock excavation, cu. yd.	3.00-1.50	3.00-1.45	2.50-1.20
Foundation timber, M. ft., B. M.	20.- 20.	15.- 15.	17.- 16
Sheeting, M. ft. B. M.	15.- 15.	15.- 15.	15.- 15.
Piling, lin. ft.	.50- .20	.50- .20	.....
Catch basins	100.-100.	155.- 85.	124 - 75.
Flush tanks	80.- 55.	160.- 55.	100.- 90.
Manholes, brick sewers.	30.- 30.	30.- 25.	.....
Manholes pipe "	40.	35.- 27.	55.- 29.
Lampholes, lin. ft.	.25- .15	.40- .25	.30
Repairing, lin. ft., trench	.10- .10	.10- .10	.10- .10
Brick haunching, per M.	.....	.18	.....
Brick masonry, cu. yd.	.....	8.00-7.00	7.00-7.00
Rubble " "	4.50-3.00	5 50-3.00	7.50-4.25
Concrete " "	7.00-3.00	7.00-5.00	6.00-3.50

It is gratifying to note that some city engineers and boards of public works are making amends for failures to issue reports in previous years, whether to be ascribed to themselves or others, and are reviewing the work of two or more years in one report. Thus the board of public works and the city engineer of Chattanooga recently reported for the period from April 1, 1890, when the board was organized, to Jan. 1, 1893.

A report by Mr. Rudolph Hering, M. Am. Soc. C. E., on a system of sewerage for Superior, Wis., is included with the report of Mr. A. S. Cooper, City Engineer. The system is being built with sewers placed in alleys, as far as possible. Mr Cooper's report contains tables showing public improvements made during the years 1888 to 1892, inclusive, and also a comparative tabular statement of public works carried out in 17 of the principal cities of Wisconsin and Minnesota.

Mr. Cooper recommends that the city buy all the cement used in sewer construction and furnish it to the contractors, the cement to be purchased after tests of samples offered and before contracts are let. Aside from insuring a better quality of cement by this method, Mr. Cooper thinks that the city might be able to get more favorable terms than contractors, as it would buy in larger quantities than any one contractor. Mr. D. A. Reed, City Engineer of Duluth, Minn., goes further than Mr. Cooper and recommends that the city buy not only cement to be used in contract work, but also brick and sewer pipe, the same to be furnished to contractors at actual cost.

The report of the Duluth Board of Public Works for 1892-3 contains a tabular statement of the cost of public improvements, giving it by years beginning with 1892. The report also gives the results of cement tests by means of tables and diagrams. Included in the same report is a table showing the highest, lowest and average price for street and sewer work in Duluth in the years 1889, 1890, 1891 and 1892, reprinted here as Table II.

TABLE II.—Highest, Lowest and Average Price for Street and Sewer Work in Duluth, Minn., in 1889, 1890, 1891 and 1892.

Class of work.	1889. Highest.	1889. Lowest.	1889. Average.	1890. Highest.	1890. Lowest.	1890. Average.	1891. Highest.	1891. Lowest.	1891. Average.	1892. Highest.	1892. Lowest.	1892. Average.
Earth excavation, cu. yd	$.40	$.20	$.28	$.40	$.10	$.24	$.60	$.22	$.34	$.60	$.10	$.35
Rock excavation, "	4.50	.50	1.66	5.00	.50	1.55	2.50	.40	1.53	4.00	.01	1.34
Borrow, "	.45	.01	.31	49	.35	.40	.60	.20	.39	.46	.25	.32
Gravel and rolling, "	1.00	.50	.78	1.00	.70	.85	1.25	.70	.97	1.25	.40	1.06
Loam, "	.55	.40	.48	.65	.30	.54	1.50	.50	.81	.75	.65	.70
Telford macadam, sq. yd.	....	....	....	....	....	....	1.10	.90	1.00	1.10	.55	.83
Cedar block pav. on concrete, "	....	....	....	....	....	....	1.80	1.80	1.80	1.47	1.47	1.47
Cedar block paving on sand, "	1.19	.93	1.07	1.25	.88	1.07	1.05	.93	.97	1.14	.90	.98
Rough stone pav. for gutters, "	1.28	.50	.83	1.10	.75	.93	1.25	.65	.96	1.20	.70	.95
Rough stone pav. in Port. cem. "	1.60	1.25	1.43	2.25	1.20	1.89	2.50	1.25	1.90	....	....	....
Pine timber in place, M ft. B. M.	20.00	15.00	17.46	20.00	15.00	17.60	25.00	15 00	19.52	22.00	16.00	19.46
Oak timber in place, " "	....	....	....	....	....	....	45.00	31.00	38.00	40.00	40 00	40.00
Piles in place, lin. ft.	.41	.01	.41	....	....	....	.18	.16¼	.17¼	.18	.18	.18
Granite curb, "	....	....	1.40	1.25	1.00	1.10	1.45	.88¾	1.11	1.32	.91	1.09
Sandstone curb, "	.93	.83	.88	.85	.61	.73	1.00	.60	.81	....	....	....
Tar, per gallon	....	....	....	....	....	....	.13	.10	.12	.14	.12	.13
Remov. and relay. sidewlks, lin. ft.	.10	.05	.07½	.10	.04	.07	.20	.02	.13	.20	.09	.13
Cast iron, per lb	.04	.03	.03¾	.06	.03	.04	.25	.03	.07	.04	.04	.04
Earth excavation in sewer, cu. yd.	.80	.35	.49	.70	.35	.57	1.00	.15	.58	1.00	.20	.61
Rock excavation in sewer, "	4.50	.50	2 61	5.60	1.50	3.89	7.50	.50	4.13	12.50	.01	3.81
24-in. pipe in concrete, lin. ft.	2.50	2.00	2.30	2 50	1.25	2.10	3.00	3.00	3.00	....	....	....
21-in. " " "	2.30	2.00	2.18	2.00	1.00	1.63	4.00	4.00	4.00	2.00	2.00	2.00
20-in. sewer pipe " "	1.95	1.60	1.82	2.50	1.00	1.91	2.00	2.00	2.00	2.00	1 85	1.93
18-in. " " "	1.90	1.30	1.57	2.00	.85	1.60	2.25	1.60	1.85	1.75	1.35	1.58
15-in. sewer pipe in sand, "	.75	.55	.63	.85	.30	.60	.90	.55	.69	1.10	.60	.71
12-in. " " " "	.75	.50	.58	.65	.70	.46	.75	.40	.53	.60	.30	.46
10-in. " " " "	.60	.16	.44	.36	.20	.30	.75	.42	.53	.50	.25	.39
9-in. " " " "	.62	.30	.38	.40	.16	.28	.45	.29	.37	.35	.25	.31
8-in. " " " "	.40	.25	.29	70	.15	25	.40	.26	.34	.45	.32	.37
6-in. " " " "	.25	.10	.18	.22	.14	.18	.30	.18	.24	.30	.18	.24
Sewer brick, per M	20.00	17.00	17.75	18.00	15.00	17.00	25.00	17.00	20.27	30.00	20.00	23.40
Cut stone masonry, cu. yd	25.00	15.00	21.75	25.00	13.00	20.00	25.00	18.00	22 73	25.00	15.00	20.60
Mortar rubble masonry, "	4.30	.80	3.08	5.00	3.00	4.10	7.50	4.00	4.87	6.00	4.00	4.65
Portland masonry, "	....	....	....	....	....	....	6.00	4.75	5.25	7.50	6 00	6.62
Pene hammered work, sq. ft.	.40	.25	.33	1.00	.30	.52	.35	.20	.28	....	....	....
No. 1 intakes	55.00	40 00	48.00	60 00	30.00	44.00	60.00	30.00	47.12	50.00	30.00	41.25
No. 2 intakes	50.00	35.00	39.20	40.00	30.00	33.75	60.00	20.00	41.66	50 00	35.00	42.10
No. 3 intakes	....	....	....	....	....	....	50.00	40.00	43.33	50.00	40.00	46.66
No. 5 intakes	50.00	30.00	38.33	....	....	....	70.00	60.00	65 00	....	....	....
No. 3 catch basins	....	....	....	....	....	....	60.00	40.00	50.00	80.00	60.00	70 00
Manholes	95 00	38.00	51.76	75.00	25 00	48.00	75.00	40.00	54.66	90.00	40.00	55.50
Lampholes	....	....	18.00	20.00	8.00	14.00	30.00	10.30	20.60	2.00	1.00	1.48
Inlets, ¾ bends	3.00	.90	1.40	2.00	.25	1.00	3.00	.30	1.48	....	....	....
Concrete, Portland, cu. yd.	....	....	....	....	....	....	....	....	....	10.00	10.00	10.00
Concrete, American. "	....	....	....	....	....	....	....	....	....	7.00	7.00	7.00

TABLE III.—Cost of Vitrified Brick Paving in Kansas City, Mo., During 1892-3.

Thickness of foundation, ins. Concrete.	Sand.	Space between brick filled with—	Total area, sq. yds.	Price per sq. yd.
6	1	Sand	1,294	$1 70
6†	2	"	1,903	1.80
6	2	"	376	1.93
6	2	"	2,618	1.74½
6	2	"	4,639	1.73
6	2	"	4 999	1.62½
6†	2	Asphalt cement	4,042	1.37
6	2	"	2,616	1.60
6	2	"	856	1.58
4	2	"	5,430	1.76
4	2	"	4,541	1.75
4	2	"	2,395	1.74

* Vitrified brick laid flat. † Old concrete.

Two 500-gallon Shone ejectors, one for reserve, are used in connection with the new sewerage system of Winona, Minn. The ejectors are to be used only when the river is above the 6-ft. stage. The air compressors are in the water-works pumping station, 800 ft. from the ejectors. The ejectors and appurtenances cost about $13,500, and the ejector chamber $2,000. About 4½ miles of sewers had been laid to April 1, 1893, and 200 connections made. Mr. Fred H. Pickles is city engineer.

The report of the Board of Public Works of Kansas City, Mo., for the year ending April 17, 1893, contains three tables showing the cost of brick and asphalt pavements and macadam roads. We reprint them somewhat rearranged for more convenient comparison. Table III. relates to brick paving and shows the material used for foundations, the method of filling joints, the area paved in each class or at each price and the several prices. Table IV. covers asphalt in much the same way, and Table V. relates to macadam. It will be noticed that there was a great variety of conditions for each class of pavements, and especially for the

TABLE IV.—Cost of Trinidad Asphalt Paving in Kansas City, Mo., During 1892-3.

Thickness of asphalt, ins.	Material and thickness of foundation, ins. Foundation proper.	Bituminous concrete binder.	Total area, sq. yds.	Price per sq. yd.
2½	Old concrete	2	6,596	$2.25
2½	Concrete, 6	.	6,492	2.80
2	Concrete, 4	..	12,350	2.50
2	Old concrete	2	19,084	2.65
2	Concrete, 6	1¼	3,642	2 65

macadam. Altogether 133,200 sq. yds. of streets were improved during the fiscal year at a total cost of $219,185. Of this 34,829 was brick, at an average cost, regardless of conditions, of $1.649 per sq. yd.; 48,164 yds. of Trinidad asphalt at $2,576; and 50,208 yds. of macadam at an average cost of 74.7 cts. per sq. yd.

The last report of Mr. J. B. Hunter, City Engineer of Denver, contains a number of colored cross-sections of a large combined trunk sewer constructed by Murphy & Nelles, under contract dated July 2, 1891. The sewer is circular and ranges from 58 to 92 ins. in diameter, the length of each size and the corresponding number of rings of brickwork being as follows:

Size, ins.	Length, ft.	Number of rings.
58	484	3
72	1,113	3
78	365	3
90	1,209	3
91	330	3
91	268	4
92	1,719	3

The 268 ft. of four-ring 91-in. sewer and also the 92-in., is built in a masonry cradle on a concrete foundation and has only one ring of brick for the invert. Three grades of brick were used in

TABLE V.—Cost of Macadam Roads in Kansas City Mo., During 1892-3.

Material.	Total area, sq. yds.	Price per sq. yd., cts.
6 ins. Osage R. gravel, 6 ins. broken rock.	1,245	77.9
" Bk. " " " "	7,179	91.
" " " " " "	1,068	88.
" " " " crushed rock.	6,382	87.
" " " " Telford base.	1,791	88.
1 in. screenings, 12 ins. broken limestone..	959	62.9
" " " broken stone.....	3,261	62.04
" " " "	2,449	58.5
1½ ins. " " " "	1,777	70.
3 ins " " " limestone.	10,033	59.5
1 in. gravel, 14 ins. macadam	1,040	82.
" " 6 ins. Bethany Falls stone, 6 ins. limestone...	5,142	85.
1 in. gravel, 5 ins. broken stone, 9 ins. Telford.....	1,514	83
1 in. gravel, 3 ins. broken stone, 9 ins. Telford.....	5,751	75.

construction, designated as A, B and C. The lower 120 degrees of the sewer, without regard to size, is of A brick and the remainder of the 92-in. and the 91-in. sewer in masonry cradle is of B brick. All the rest of the sewer has its inner ring, save the lower 120 degrees, and the lower half of the second ring, of B brick and the upper half of the second ring and the whole of the outer ring of C brick.

The promptness of the publication of the report of Mr. M. B. Haynes, City Engineer of Mankato, Minn., is to be commended. The report is for the year ending Dec. 30, 1893, and was in print within 30 days from that date, at the most.

Tables and diagrams relating to travel on certain streets and results of cement tests at Montreal in 1892 are given in the report for that year of Mr. Percival W. St. George, City Surveyor. The report of Mr. E. H. Keating, M. Am. Soc. C. E., City Engineer of Toronto, Ont., also contains some diagrams relating to extended cement tests. In addition there are included in Mr. Keating's report a number of large folding sheets of illustrations of various classes of work done under his direction and maps showing the extent of different public improvements.

The Toronto report gives in detail the cost of sewers built by contract and by day labor in 1892. In our issue of Dec. 22, 1892, similar figures were given for work done at Toronto in 1891, the figures having been rearranged by sizes of sewers, character of soil and depth of cut.

The cost of 48,424 sq. yds. of brick street pavements on concrete foundation, laid on 11,217 lin. ft. of streets, at Dunkirk, N. Y., in 1891 and 1892, averaged $4.32 per sq. yd., including all expenses. On a broken stone foundation 7,433 sq. yds. were laid on 1,631 ft. of street for about $2.25 per sq. yd. Mr. F. A. Dunham is city engineer.

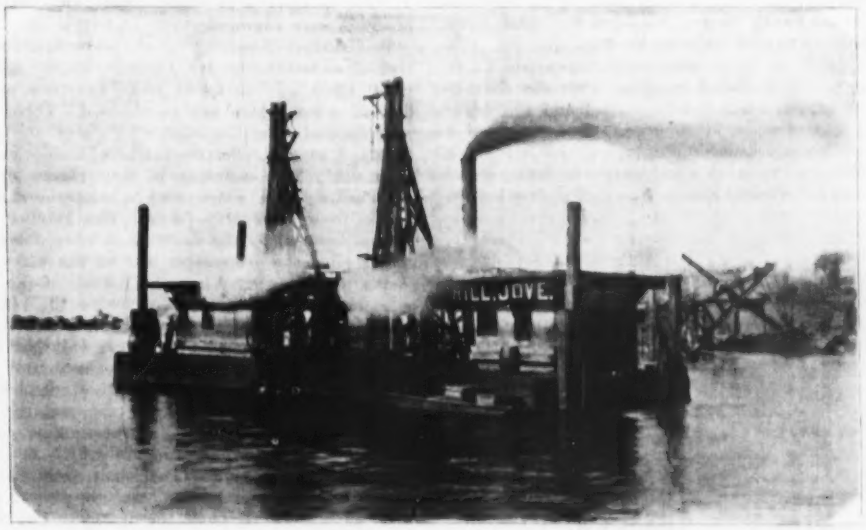
At Davenport, Ia., in 1892, brick paving to the amount of 40,536 sq. yds., involving 27,974 cu. yds. of excavation, and including 16,195 lin. ft. of curbing and 15,680 ft. of drain tile, was completed at a total cost of $93,161, or $2 per sq. yd. The work was done by three different contractors. Of the total cost 75% was assessed upon abutting property, 10% was paid by the Davenport & Rock Island Ry. Co. and 15% by the city, the latter representing the cost of street and alley intersections. The average width of the paving was about 45 ft.

ROCK EXCAVATION UNDER WATER, AT OSWEGO, N. Y.

In the last annual report of Capt. Dan C. Kingman, Corps of Engineers, U. S. A., is an interesting report by U. S. Assistant Engineer Wm. Pierson Judson, on the removal of rock in the inner harbor at Oswego, N. Y.

The purpose of the excavation was to provide a uniform depth of 15 ft. at extreme low water over an area of about 4,500 sq. yds. Over about seven-tenths of this area the rock to be removed had a face of 1 ft. or less, and over the rest the face was 2 ft. or less. The rock itself was a graywacke sandstone in horizontal strata from 1 to 2 ft. in thickness with seams in the upper layers in which the drills often jammed. The rock varied greatly in hardness, the drill often cutting 10 ft. without sharpening, and again wearing dull in cutting 1 ft. The quantity of rock to be excavated was measured at 2,956 cu. yds., and the contract for drilling, blasting and removal was let to Hingston, Rogers & O'Brien, of Buffalo, N. Y., for $2.75 per cu. yd. measured in place. Work was commenced on May 4, 1893, and on June 30, 1893, the date of the report, 85% of the work had been completed.

The low cost and rapid execution of this rock excavation are doubtless due to the efficiency of the plant employed. This plant is described practically as follows by Mr. Judson: The heavily built drill scow was 82 ft. long, 26 ft. wide, 6½ ft. sides, and drew 2¼ ft. of water. This scow was built as follows: The bottom was made of 8-in. oak laid crosswise and bolted to two 10×10-in. longitudinal oak stringers and two 10×12-in. oak side pieces. The sides were made of 6-in. pine laid lengthwise and edge-bolted and rivet-bolted to vertical oak frames 12 ft. apart. The deck was laid with 3-in. pine, crosswise. This scow, after a season's work, leaked very little and showed no ill effects from blasts fired directly beneath its side in a depth of water of 12 ft. or more. On deck, a house, 72×14 ft. and 10½ ft. high, contained the boiler, spud and capstan engine, steam pump, blacksmith shop, etc. Upon the deck of this scow, on one side of the house, was a 6½-ft. track carrying two drill frames each mounted on a separate truck. Each



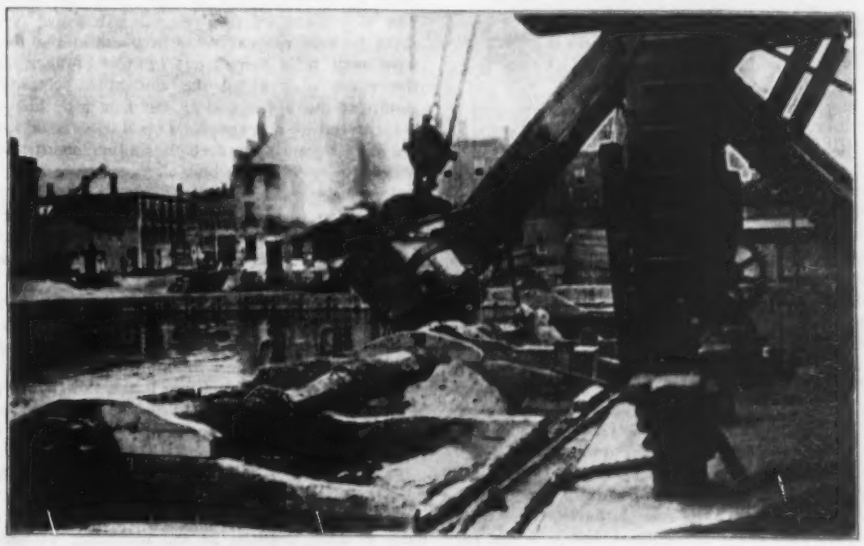
GENERAL VIEW OF DRILLING SCOW

truck could be moved by two men operating a 5-ft. lever and ratchet engaging in a 10-in. pinion on each truck shaft.

Each drill frame carried a No. 5 Ingersoll rock drill, with a 5-in. cylinder and a 7-in. stroke. The only peculiarity of the drill was that it was attached to the 6-in. piston of a 12-ft. hydraulic cylinder set vertically in the top of the drill frame. This hydraulic hoist was useful in quickly raising and lowering the heavy drills. But its special value appeared when the drill became jammed in one of the numerous seams in the rock. Under such circumstances, with drills handled by ordinary methods, a delay of several hours in releasing the drill would often occur. The hydraulic hoist, however, could instantly drag the drill out, enabling the same hole to be started again, or the drill to be shifted to a new site, as desired.

The hydraulic hoists were operated by a duplex Blake pump with 7½-in. steam cylinder, 4½-in. water cylinder and 10-in. stroke, working under 80 lbs. steam pressure. The water pressure was supplied to each drill frame separately by a set of 2-in. pipes, each fitted with three loose elbow joints and passing over the roof of the house so as to permit free motion of the drill frames along the track. The steam pipes supplying the drills were fitted in the same way, and none of these pipes were wrapped and all leaked a little at the elbows.

Steam, for the two drills, the pump and a 15-HP. engine for raising and lowering the four anchor spuds and operating three steam capstans, was supplied by a horizontal tubular boiler of about 30 HP. This boiler was 12 ft. long and 52 ins. in diameter, with 72 2¼-in. tubes 7 ft. 4 ins. long; the grate surface was 20 sq. ft. and steam pressure was limited to 85 lbs. The total consumption of bituminous coal is given at 1½ tons for a working day of 22 hours. There were two crews of six men each and a blacksmith and helper serving both crews.



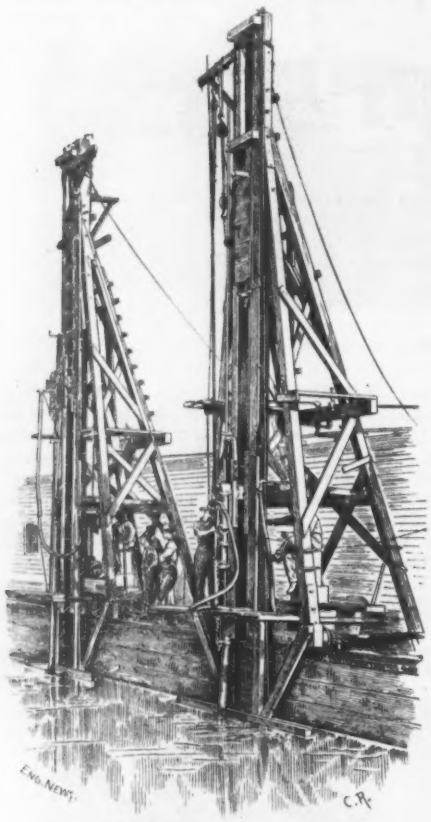
BLASTING ROCK IN DIPPER OF DREDGE.

The work to be done was carefully platted on a large scale, as determined from the soundings, and 10 ft. range marks were established by the local inspector on the wharves on both sides. By this arrangement the drill could be readily located within 1 ft. and each position of the drill boat was recorded upon the chart as soon as all the corresponding holes had been drilled and blasted. The progress of the dredge was also recorded in the same way upon a duplicate chart.

The method of operating the drill boat was as follows: It was hauled into the desired position, lengthwise with the river, by the steam capstan or tug and anchored by the four spuds, one at each corner. Two of these spuds were 14×14-in. oak, located on the drilling side, and the other two were 12×12-in. oak. When in position one drill

was moved to the upstream end of the boat and the other was placed midway. A 4½-in. casing pipe was then lowered and forced into the loose gravel overlying the rock; this pipe extended 2 to 4 ft. above water and had a double T about 2 ft. above the bottom to allow the escape of the drill chips. The pipe remained in position until the hole had been drilled and the cartridge placed ready for firing. While the opening in the casing pipe was usually sufficient, if it became necessary to clear the drill hole a ½-in. pipe, 24 ft. long, and connected to the force pump by a 1-in. hose, could be lowered to the bottom of the drill hole.

The drill is 26 ft. long, with the upper 14 ft. made of 1¼-in. round machine steel; the next 10 ft. of 1¾-in. round machine steel and the lower 2 ft. 2-in. octagon steel, upon which is forged a 3¼-in. diamond-point square cross, tempered in a saturated solution of equal parts, in bulk, of sal ammoniac, salt and alum. The drill is first hoisted



Drills, with Hydraulic Lifting Apparatus.

by hand tackle and is lowered into the casing pipe. The discharge from the hydraulic cylinder is then opened and the drill cylinder is lowered until its chocks rest upon the head of the drill, where it is clamped. Steam is then turned on and the drill set to work, while the hydraulic hoist is kept in constant use to raise and lower the drill as needed.

The holes are drilled 2 to 4 ft. below grade and they are spaced 5 ft. apart upon lines 5 ft. apart. The holes run from 4 to 7 ft. deep; the average for 1,000 holes being 5¼ ft. With the rock fairly clean and free from seams, 5¼ ft. may be drilled in 30 minutes; though it may require three hours under other conditions. The average of 1,000 holes was 5¼ ft. in one hour. The maximum penetration of the drill was 1 ft. in four minutes. The drill is sharpened as often as required, but it is not repointed until it cuts a 2½-in. hole. About 12 drills per 22 hours are repointed, using about 20 ft., or 240 lbs. of 2-in. octagon steel for about 6,000 ft. of drill holes.

After the hole was drilled and the drill hoisted out, a 2¾-lb. cartridge of 75% dynamite was obtained from the magazine-boat. This cartridge was 2 ins. in diameter and 18 ins. long and carried in its center a Laflin & Rand fulminate exploder with 4-ft. wires, which were secured by a clove hitch around the middle of the cartridge. "Atlas" and "Climax" powders, each containing 75% of nitro-glycerine, were used with good effect. The best results were obtained when the makers were notified that the explosives were intended for submarine work. They were then packed in waterproof cases, which insured more perfect combustion.

The majority of the fish which came to the surface, as the result of an explosion, were merely stunned and soon recovered if left alone. The few fish killed outright seemed to be those which chanced to be in actual contact with the bottom at the time of explosion. Their spines were broken at the junction with their heads and their air bladders were ruptured.

The further handling of the cartridges is described as follows by Mr. Judson: To the ends of these wires the workmen twist the ends of the leading wires which run to the reel. There is a separate reel of leading wire, with a separate Laflin & Rand magneto-electric machine beside it, for each drill. The cartridge is then placed in the iron loading pipe, which always hangs by a small tackle from each drill frame. The loading pipe is then lowered by the drillman steadily down the casing pipe, the drillmaster holding the wires and easing them down. When the bottom of the hole is reached, the drillmaster unclamps the plunger which works within the loading pipe, and forces it down steadily upon the cartridge, while the drillman slowly hoists the loading pipe until it is free of the cartridge, which is thus left at the bottom of the drill hole. The loading pipe and rod are then withdrawn, leaving the wires leading up out of the top of the casing pipe in which the drill worked. To this casing pipe a chain from the hydraulic hoist is then hooked, and the casing pipe is raised 4 or 5 ft. from the bottom. The drillmaster then goes to the reel and attaches the ends of the leading wires to the binding posts of the magneto-electric machine, and the explosion is at once made. No attempt is made to couple two or more holes together nor to remove the drillboat from over the blast. The amount of dynamite used in each hole varies from 2 to 6 lbs., 2¾ lbs. being the usual quantity.

The loading pipe is a device worthy of description: Its lower end, which receives the cartridge, is a 2⅛-in. pipe 3 ft. long, with a ⅜-in. slot for its full length. The edges of the pipe at the sides of the slot are smoothed and rounded to avoid injury to the insulation of the fuze wires. The upper end of this slotted pipe joins a pipe of 1-in. bore and 22 ft. length, within which works a plunger rod ¾ in. diameter and 27 ft. long, having a 2-in. head at its lower end to rest upon the cartridge. The slot described receives the wires and permits them to hold the cartridge in place in the loading pipe until it is forced out by the plunger, when the wires slide along the slot until released. A clamp at the upper end of the 1-in. pipe holds the plunger rod until wanted. This device is of special interest, because on former similar operations of which the writer has had charge it has been considered necessary, in order to avoid premature explosions, to use a wooden rod to ram home the dynamite, and a copper or lead tube in which to hold the cartridge. This present device is all of iron and it works perfectly and safely.

The entire operation from the time of stopping the drill to the explosion, as just described, requires three minutes in ordinary work and may be done in one and one-half minutes. To shift the drill 5 ft. to its next position, lower the casing pipe into place, put the drill in its chocks, and start the drill again on a new hole, occupy about two minutes, and can be done in half this time.

The drillboat being 82 ft. long, and the drills being able to travel the full length, as before described, 14 holes, 5 ft. apart, can be made and fired at each position of the drillboat. Generally the rock is broken into pieces of 1 and 2 cu. ft. each, of which the dredge brings up a cubic yard or more in each dipper load. Occasionally a piece of 1 or 2 cu. yds. is brought up, which is too large to drop through the dipper. In such cases the dipper is rested upon the dump scow while a hole is drilled in the rock with a hand drill; 6 to 8 oz. of dynamite are then packed into the hole, which is plugged with a handful of cotton waste. The explosion breaks the rock without injury to the dipper or scow.

We reproduce a photograph of this operation taken at the instant of explosion. The fragments of rock are really scattered for 200 ft. or more, but they had not yet started when the view was taken. To obtain this photograph the shutter of the camera was set for 1-25 second, and its trigger was put in the same circuit with the electric exploder, with the result that the exposure and explosion were simultaneous.

While the exact cost of execution to the contractor is not known, Mr. Judson estimates this on a basis of 1,000 cu. yds. of rock. For this 1,650 holes, aggregating 8,660 lin. ft., must be drilled in 33 days of 22 hours each. On this basis he presents the following estimate:

For 33 days' wages of drill crews, at $31	$1,023.00
For 4,000 lbs. of 75% dynamite, at 17 cts.	680.00
For 1,800 platinum fuse electric exploders, at 3 cts.	54.00
For 49½ net tons bituminous coal, at $3	148.50
For 42⅞ gallons cylinder oil for drills, etc., at 30 cts	12.70
For 55 gallons kerosene oil for lanterns, at 12 cts.	6.60
For 260 lbs. octagon steel for drill bits, at 15 cts.	39.00
For 55 lbs. machine steel for drill bars, at 4 cts.	2.20
For general machine-shop repair bill, at $1 per day	33.00
Total	1,999.00

The result of this expenditure would be to break up not only 1,000 cu. yds. of rock above grade, and for which the contractor alone was paid, but also probably an equal amount below grade. The dredging of this rock is slow owing to the many irregularities in the surface. To remove the amount estimated above would require about 10 days' work of 10 hours each, costing, say, $500. This added to the above makes $2,499 for 1,000 cu. yds. of rock drilled, blasted and removed from above the grade line; or, say, $2.50 per cu. yd.

THE MANCHESTER SHIP CANAL.

The Manchester Ship Canal is described and very fully illustrated by our enterprising London contemporary, "Engineering," in a special issue of 56 pages of text and cuts. It is by far the best and most complete history of this work that has yet come to us and from it we give the following brief abstract with a reproduction of the general plan:

The first practical step toward the construction of the present canal was taken by the late Mr. Daniel Adamson in June, 1882. He called a meeting at his house to discuss the best means of giving Manchester access to the sea and as a result plans were later submitted by Mr. Hamilton Fulton and Mr. E. Leader Williams and studied by Mr. James Abernethy, who was consulting engineer from that time to the completion of the work. At the close of 1882 a bill to authorize the construction of the Manchester Ship Canal, at an estimated cost of about $26,000,000, was presented to Parliament and a battle was begun with some of the most powerful transportation corporations in England opposed to the scheme. Beaten at first, the promoters of the canal returned to the attack backed by such eminent engineers as Mr. E. Leader Williams and Mr. Abernethy, Sir John Fowler, Sir Benjamin Baker and Messrs. Bateman, Brunlees, Messent, Dees and Wells. The opposite side engaged the services of Sir J. W. Bazalgette, Sir Frederick Bramwell and Messrs. Stevenson, Lyster, Manning, Harcourt, Deacon and others. The late Captain Eads was also engaged by the Mersey Dock and Harbor Board at a fee of $20,000, and it is said that during the 28 days of inquiry the expenses were piled up at the rate of $25 per minute. The bill was finally again thrown out, an event largely due, it is said, to the evidence offered by Captain Eads. In 1885 a new and third scheme was presented to Parliament, and after a due amount of parliamentary battling it was finally passed by both Houses and received the Royal Assent on Aug. 6, 1885, after an estimated expenditure by both sides in these preliminaries to work of about $1,750,000.

A prospectus for raising funds for actual construction was issued by the Rothschilds on July 20, 1886, but the subscriptions did not come in as expected, and the first attempt was practically a failure. Later, the Rothschilds and Barings united in submitting fresh proposals, and this time the money was forthcoming and on June 8, 1887, a contract was entered into with the late Mr. Thomas A. Walker for $28,750,000, to finish the canal in four years. Ground was broken on Nov. 1, 1887,

and from that time until completion the work went on continuously though not without its vicissitudes.

Until the latter part of 1889 all went well; but Mr. Walker died in November of that year and it soon became evident that more money was needed to complete the work than the original estimate provided for. In March, 1891, the Manchester Corporation voted to loan the company further sums of money as shown below in a concise statement of the capital and expenditures of the canal company to June 30, 1893:

Capital.		
Ordinary shares		$20,000,000
Preference shares		20,000,000
		$40,000,000
First mortgage debenture	$9,060,000	
Second " "	3,000,000	
New mortgage, Manchester Corporation loan	25,000,000	$37,060,000
		$77,060,000
Capital Expenditures to June 30, 1893.		
Bridgewater Canal plant		$8,910,863
Land purchase, compensation and expenses		5,806,735
Construction of works, including plant		44,308,800
Engineering and surveying		627,163
Interest on share and loan capital after deducting balance of general interest account		5,192,500
Parliamentary expenses, 1885 to 1893		817,965
Law charges and disbursements		104,100
Brokerage, advertising and other expenses of issue of debentures		544,165
Expenses for same by Manchester Corporation		158,500
Other general expenses		880,320
		$67,351,105

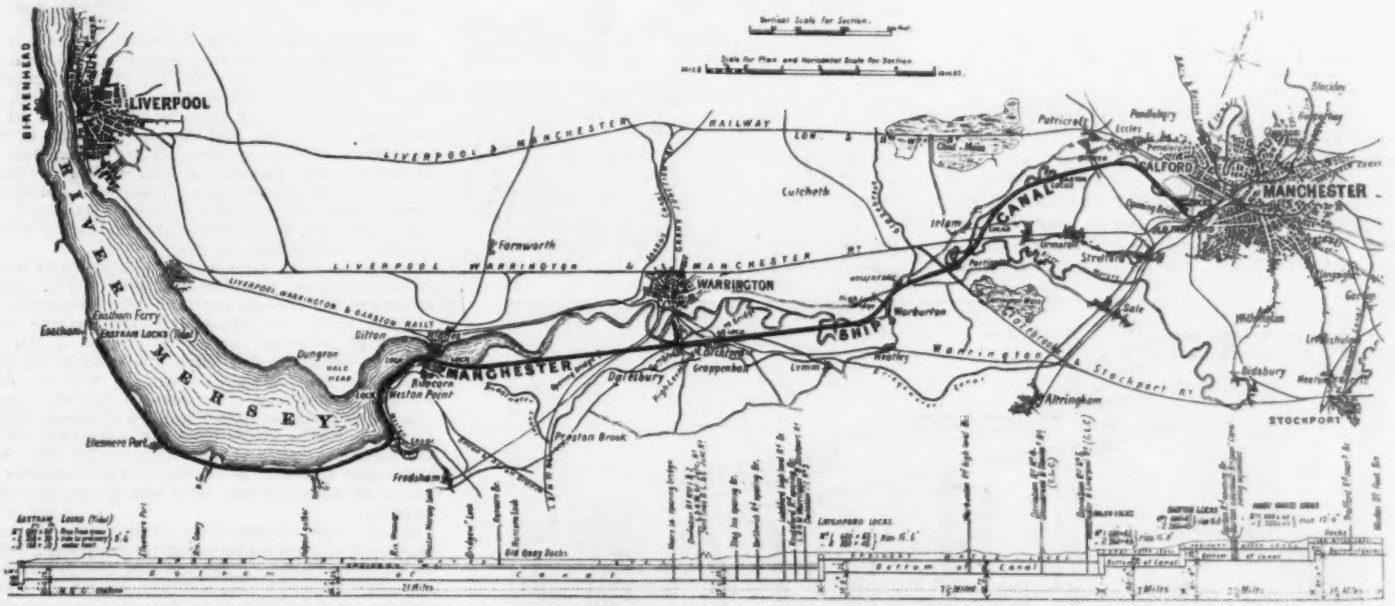
To the same date the Bridgewater Canal had an accumulated credit account of $1,779,545. The interesting, especially in its many bridges and viaducts. "Engineering" illustrates these very fully by a series of photogravures of the completed works, and includes in its description the canal itself, and its locks and sluices. It is not the purpose to describe these works here; but for general reference we reproduce the following table of distances and water levels on the canal as being more complete than we have heretofore published:

Section.	Distance from Eastham Locks, miles.	Length of section, miles.	Rise in Locks. Lift at each lock, ft.	Rise in Locks. Above mean tide in Mersey Estuary, ft.
Eastham	21	21	....	9.5
Latchford	28½	7½	16.5	26.0
Irlam	30½	2	16.0	42.0
Barton	33¾	3¼	15.0	57.0
Mode Wheel	35½	1¾	13.0	70.0
Total	35½	35½	60.5	70.0

As seen above, the total length of the canal is 35½ miles; the level of water in the Manchester docks is 60.5 ft. above the normal level in the semi-tidal part of the canal and 70 ft. above mean tide in the Mersey Estuary. The minimum depth of the canal is 26 ft. and the width is as follows: In the upper section, from Manchester to Barton, or for five miles, the bottom width is 170 ft. Between Barton and Eastham the bottom is 120 ft. wide, and at water level the canal is 172 ft. wide. Except at the locks the narrowest part of the canal is at the Runcorn high level bridge, where the clear distance between the first river pier and the abutment is only 92 ft. The high level railway bridges give a clear headway of 75 ft. above the at the shore ends of the canal. The water-tight joint on the bridge is made by a steel V-piece closing on a flat steel bar. To make a joint between the bridge and the canal a U-shaped wedge, 2 ft. wide and corresponding to the section of the canal is used. To open the swing, the gates on the canal and on the bridge are first closed and the water allowed to escape from the short section between the gates. The U-wedge, weighing 12 tons, is then raised by four hydraulic jacks from the tapering seat in which it normally rests, and the clearance thus provided allows the bridge to swing.

The dredging and excavating plant was very elaborate and included many types of machines, which it would be useless to attempt to describe here. As to the materials used and quantities, we have the following notes: The total material removed to form the Manchester Ship Canal is calculated to amount to 53,500,000 cu. yds., of which 12,000,000 cu. yds. were sandstone rock. Of these totals, 11,500,000 cu. yds. of rock were removed by excavation and 500,000 cu. yds. by dredging. Of the softer material, 38,500,000 cu. yds. were excavated and 3,000,000 cu. yds. were dredged. The rate of excavation varied from 750,000 cu. yds. to 1,250,000 cu. yds. per month, according to the difficulty of the work. All quays and walls are made of brick or concrete; the total brickwork amounting to 175,000 cu. yds.; the concrete work amounted to 1,250,000 cu. yds., and there were 220,000 cu. yds. of masonry in piers and bridge abutements.

The chief engineer of the work throughout was



GENERAL MAP AND PROFILE OF THE MANCHESTER SHIP CANAL.

amount of land purchased amounted to 4,520 acres, and the company has now a surplus of 2,500 acres available for resale. The excess of actual cost over the original estimate is explained in part by the death of Mr. Walker, involving the failure of his contract and the performance of much of the more costly work by the company, by the delay of two years, adding vastly to the interest account, and by the floods of 1889.

On June 19, 1891, water was first admitted to the canal from the Mersey Estuary, at Ellesmere Port; on July, 1891, at Eastham Locks; in September, 1891, navigation was opened to the mouth of the River Weaver, at Weston Marsh Lock, and on July 22, 1892, Saltport was established as a new port in the United Kingdom. Early in 1893 the high level viaducts over the canal were opened to traffic and on Nov. 25, 1893, the water was admitted to all parts of the canal and that part of the work was practically completed—within 11 years after the first bill was deposited in Parliament; 8¼ years after the act was passed authorizing the canal, and six years after construction was actually commenced.

The canal as an engineering structure is very water surface; swing bridges have a headway of 16 ft. The Eastham locks at the entrance are three in number, lying side by side, and the rise in each lock is 9½ ft. from mean level in the Mersey to normal canal level. The dimensions of the locks are as follows: One 600 ft. long by 80 ft. wide; one 350 ft. long by 50 ft. wide, and one 150 ft. long by 30 ft. wide. The gates of the locks are operated by hydraulic power. The locks on the other parts of the canal are generally similar to those at Eastham, except that they are without storm gates.

There are seven swing bridges over the canal. These have a long and a short arm; the long arm ranging from 111 ft. to 148 ft. The Barton swing viaduct, carrying the Bridgewater Canal over the ship canal, is the largest and most novel of the series. This is practically a trough built of angles and ⅝-in. plates; the extreme length of the main girders being 234½ ft., and the width from c. to c. of chords is 22¼ ft. The depth at the middle is 33 ft., tapering to 28¾ ft. at the ends. The tank is 19 ft. wide and 7 ft. deep to the timber fender-rails. This aqueduct is always swung full; this being accomplished by iron gates on the bridge and Mr. E. Leader Williams, with Mr. James Abernethy Past Prest. Inst. C. E., as consulting engineer. Sir Benjamin Baker was also consulting engineer on the part of the Manchester Corporation, after that body took an active interest in the enterprise. As chief contractor the late Mr. T. A. Walker personally organized the work, and to his energy, skill and experience the rapid progress of the earlier work on the canal was due. After Mr. Walker's death, in 1889, Mr. John Jackson and Mr. C. J. Wills took up the work of construction.

The commercial aspects of the canal are quite fully discussed, and from it we make some abstracts. Mr. Marshall Stevens, the general manager of the ship canal, some time ago estimated that seven years after the canal was opened there would be a traffic of about 9,650,000 tons, the annual revenue from which would amount to $7,461,000. To this he added $325,000 income from the Bridgewater Canal; $250,000 from rental of company land and some other items, making a grand total of $8,036,000. He estimated the working expenses at $535,000 per year, thus leaving a net revenue of about $7,500,000. This somewhat roseate forecaste is not generally accepted; but

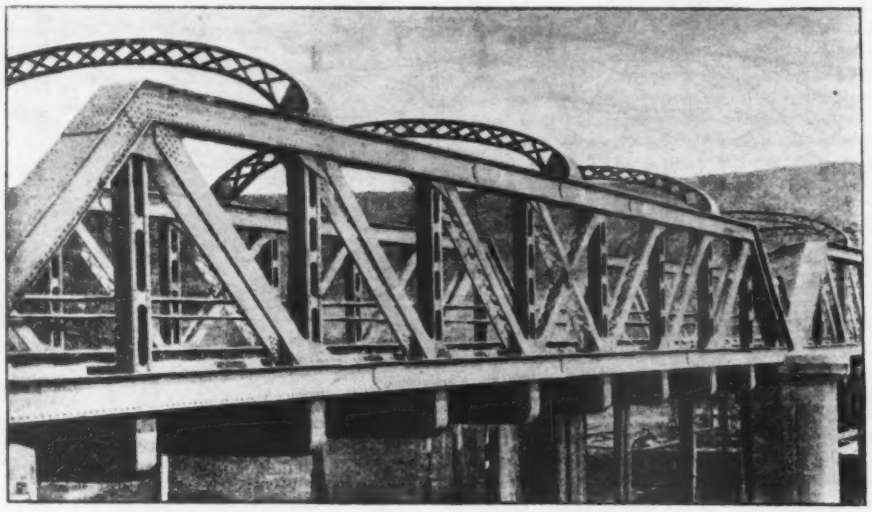
Mr. Stevens sticks to his figures and he shows voluminous statistics to prove them. The one item of cotton alone for Manchester, about 500,000 tons, costs 13s. 6d. per ton to bring it by rail from Liverpool, as against 6s. per ton charged by the canal. The railways and canals charged 7s. 2d. for transportation alone, while the remainder of the 13s. 6d. is made up of dock and town dues in Liverpool, porterage, quay attendance and cartage. It is not plainly stated, however, just how much of this work the ship canal proposes to do for 6s., or the 7s. which the company's act fixes as the maximum limit. Mr. Stevens estimates that within two years from the completion of the canal, a total revenue from tolls could be secured amounting to $3,970,865; to this he adds the revenue from the Bridgewater Canal and other sources, making a total sufficient to pay all working expenses and provide interest on a capital outlay of $75,000,000. The final outcome, however, seems somewhat vague, and depends very much upon the attitude taken by the railways, other canals and the Liverpool Corporation, now that their monopoly is destroyed.

A LESSON FOR AMERICAN BRIDGE ENGINEERS.

As it is always profitable "to see oursel' as ithers see us," we quote the following editorial comment on the late accident at the Louisville & Jeffersonville bridge from the last issue of our London contemporary, the "Engineer." The quotation is in full, nothing more being said beyond a partial reprint of the facts from these columns and elsewhere:

Another of those monster birdcage structures in the form of a pin bridge, with side girders of about 90 ft. in depth and with the lateral stiffness of the side of a suburban garden division fence, has failed with terribly fatal effect.

To show how natural is this British disgust at bad bridge practice in general and "lateral stiffness like a garden fence" in particular, we reproduce from the same issue of our contemporary the accompanying view of a new railway bridge just completed over the Trent River, near Nottingham, by the most progressive and prominent railway of Great Britain, the Midland Ry., referring



PONY TRUSS BRIDGE ON THE MIDLAND RY., ENGLAND.

our readers and our contemporary to our issue of Oct. 6, 1892, for an illustration from recent British history of the tendencies in and natural end of such a structure; which tendencies must have been thus brought into prominence some months before the design of this structure was undertaken. We forbear to comment in more detail on the bridge here illustrated, which will interest, if not edify, American engineers, further than to say that it is a double-track, three-span structure, each span being 108 ft. 9 ins. over all and consisting of two pony trusses spaced 28 ft. 6 ins. c. to c., and 16 ft. high from bottom of floor beams to top of posts. The floor beams are 2 ft. 9 ins. deep; the cover plate of the end post and top chord is 30×9-16 ins.

A FREE ADVERTISEMENT.

(From the advertising columns of the New York "Tribune," Nov. 21, 1893.)

THE INDESTRUCTIBLE PILE AND PIER COMPANY

Incorporated under the laws of the State of New Jersey.

CAPITAL STOCK $1,000,000, DIVIDED INTO 10,000 SHARES OF $100 EACH, FULL PAID AND NON-ASSESSABLE.

Stockholders have no individual liability whatever.

The company has purchased and now owns all the rights, titles, patents, and interest in and the sole, absolute, and exclusive right to manufacture and sell Indestructible Piles for building piers, jetties, docks, breakwaters, and railroad trestles, under United States patents.

Among the officers and large stockholders are Geo. W. Dunn, president of the company; Clarence Delafield, member American Society Civil Engineers, Consulting Engineer; Howard Swineford, Capitalist, Richmond, Va.; W. M. Shipp, Cashier Deposit Bank, Midway, Ky.; Geo. D. Hilyard, Builder, New York; A. S. Service, Cashier First National Bank, Sharon, Pa.; R. A. B. Dayton, Counsel of the company, and other well-known practical financiers and business men whose names are at once a synonym for honest, judicious management, and a guarantee that any enterprise in which they invest is sure to be successful.

EXTRACT FROM MR. DELAFIELD'S REPORT.

"There is an enormous demand for our indestructible pile from many railroads having piles and trestlework across the numerous rivers, bayous, bays, and creeks. Fifty thousand piles can be sold per year at an average profit of $5, giving a yearly profit from this source alone of $250,000.

"In the construction of permanent piers around New York, Jersey City, Brooklyn, and other cities, contracts now in view of over $1,000,000 per year will yield over 20 per cent. profit.

"In the preservation of coast shores, such as those at Coney Island, Long Branch, &c., &c., where property to the extent of hundreds of thousands of dollars is being lost annually by the encroachment of the sea, we can form piers at a fair profit of at least 20 per cent. of the losses now made.

"To provide additional working capital to enter upon these contracts and manufacture the quantities of piles required by the railroads, commerce and the government, the company should offer some of its stock for sale.

"From the fact that the company has an absolute monopoly and will be content with only ordinary profits, it will readily be seen that an immense permanent and lucrative business can be established. I predict that Indestructible Pile and Pier stock will be worth at least three times its par value of $100."

The many highly successful water-works erected by Mr. Delafield during the past thirty years are solid evidence of his great ability as a civil engineer, and give additional weight to his report, which commands the respect and attention of the engineering world.

The company has no indebtedness of any kind.

A limited amount of stock will be sold at $20 per share in lots to suit purchasers.

Application will be made to list the shares on the Stock Exchange.

The right is reserved to advance the price without notice, or to reject any application for stock and to allot only a part of the shares applied for.

Investors can secure stock now at $20 per share by addressing the Indestructible Pile and Pier Company, No. 2 Wall Street, New York, and remit by check, draft, money-order, or by express, or they can have the stock certificates sent to them C. O. D. by express.

(Copy of letter mailed in response to advertisement.)

New York, Nov. 27, 1893.

The Indestructible Pile & Pier Co., 2 Wall St., New York City:

Gentlemen: We notice an advertisement of your company and are interested to know what process you have adopted and propose to control for making piles teredo-proof. Would you kindly furnish us numbers and dates of your patents and particulars of any tests which you have made on piles treated by your process?

Yours truly,

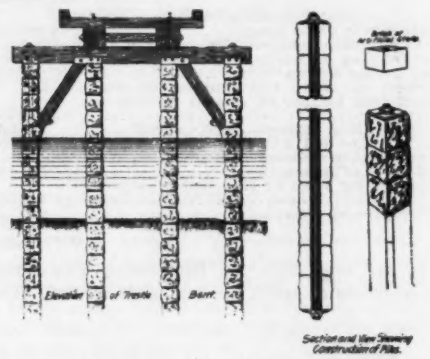
——— ——— ———,

Assoc. Ed. Engineering News.

(Extracts from circular received as the reply to above letter.)

Piles for marine structures in the varied applications now in use are notoriously short-lived by reason of decay and the ravages of the "Teredo navalis" and other worms. Creosoting, copper sheathing and sundry other devices to protect the wooden piles have been tried with only limited success, as the slightest imperfections permit access by the worms. A durable, indestructible pile is greatly needed.

Engineers have long sought for some durable, reliable substitute, but until now the difficulties have been apparently insurmountable. We manufacture a pile, either of stone—natural or artificial—terra cotta or any material indestructible on exposure to air, water or marine worms.



Section and View Showing Construction of Pile.

The pipe passing through the sundry blocks may be of any length and strength adapted to the required conditions, and the piles can be easily lengthened, when in position, by adding more pipe and blocks.

There is nothing new in using the hydraulic jet in pumping down a pile, and the pipe in centre of pile is utilized for this purpose. It is evident that a powerful pump, throwing a 2-in. stream of water under 250 lbs. pressure per sq. in., will rapidly excavate sand, clay or other material, and allow the pile to sink to a hard, solid foundation capable of sustaining a full load on the pile.

Gravel and small stone will be no impediment in excavating for piles, as a stream of water, 1½ in. nozzle, under 100 lbs. pressure per inch, will disintegrate an ordinary brick wall. When durability and the comparison of perpetual service as against a life of from six months to five years is considered, the cost sinks into insignificance. The cost, however, does not count when used other than as individual piles.

In the construction of bridge piers of masonry built upon piles driven in the river bed and sawed off at the surface of the mud, the Indestructible Pile compares most favorably as to cost, is vastly superior in lateral strength and can be placed in position with certainty.

In our improved pile it is evident that the pile forms a dowel, and no lateral strain can possibly slide one stone over another. The structure thus formed has a strength laterally and vertically greater than possible in any mass of masonry depending upon gravity. Hence a pier of a series of Indestructible Piles projected into the ocean would successfully contend with wave action that no ordinary massive masonry could resist.

We offer an ABSOLUTELY INDESTRUCTIBLE PILE to engineers and contractors, for use singly, in clusters, or to form a solid pier to any height, without the use of divers, caissons, cofferdams, etc.

By reference to the illustration the single pile will be seen to be composed of a pipe of any desired length, having a nut and large washer on either end. Upon this pipe are placed a series of blocks that may be either natural or artificial stone or brick, these blocks being jointed with cement mortar.

It will be seen that by screwing the nuts down upon the mass of masonry, the pipe and stones will form a POWERFUL INDESTRUCTIBLE HOLLOW PILE.

The method of putting this in position by means of a derrick or other suitable device needs no special description. Then a hose coupled to the upper end of the pipe, the hose being attached to a powerful pump, and the pile can then be pumped down to any depth the stream of water may have force enough to excavate, the pile going down by gravity until hard bottom is reached.

The illustration exhibits the use of these piles for bents or trestles in railroad use, and gives a mode of very strong framing in accordance with the permanence of the piles.

(We have briefly commented on the above in our editorial columns.)

EQUIVALENT UNIFORM LOAD DIAGRAM FOR 10-FT. TO 75-FT. SPAN BRIDGES.

We are indebted to Mr. Alfred M. Mosscrop, of Rochester, N. Y., for the accompanying diagram showing the uniform loads producing the same maximum end shears and bending moments for bridge spans from 10 ft. to 75 ft. long, as would be caused by the actual wheel loads of the three well known wheel load diagrams illustrated. This diagram explains itself and it need only be said here that the maximum bending moment is computed by the method given by Mr. J. C. Bland, in Engineering News for Feb. 2, 1884, and the maximum end shear computed on the assumption that a wheel can be placed over the bearing. It is also to be noted that the loads given in the wheel load diagram are for one rail only. The diagram has been computed and drawn with great care and should prove of value to any one using these types of engine loads.

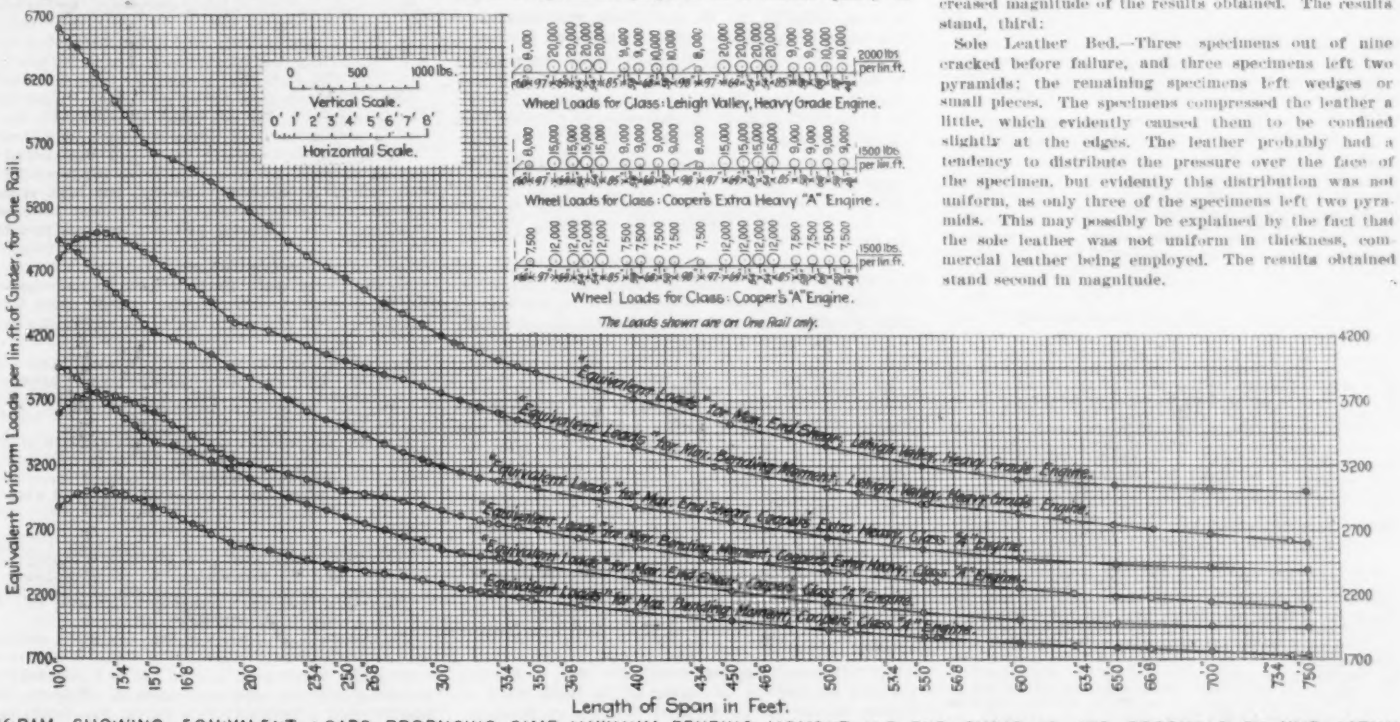

Equivalent Uniform Loads per lin.ft. of Girder, for One Rail.
Length of Span in Feet.
0 500 1000 lbs.
Vertical Scale.
0' 1' 2' 3' 4' 5' 6' 7' 8'
Horizontal Scale.
Wheel Loads for Class: Lehigh Valley, Heavy Grade Engine.
Wheel Loads for Class: Cooper's Extra Heavy "A" Engine.
Wheel Loads for Class: Cooper's "A" Engine.
2000 lbs per lin. ft.
1500 lbs. per lin. ft.
The Loads shown are on One Rail only.
"Equivalent Loads" for Max. End Shears, Lehigh Valley, Heavy Grade Engine.
"Equivalent Loads" for Max. Bending Moments, Lehigh Valley, Heavy Grade Engine.
"Equivalent Loads" for Max. End Shears, Coopers Extra Heavy, Class "A" Engine.
"Equivalent Loads" for Max. Bending Moment, Coopers Extra Heavy, Class "A" Engine.
"Equivalent Loads" for Max. End Shears, Coopers, Class "A" Engine.
"Equivalent Loads" for Max. Bending Moment, Coopers, Class "A" Engine.

DIAGRAM SHOWING EQUIVALENT LOADS PRODUCING SAME MAXIMUM BENDING MOMENT AND END SHEAR AS ARE PRODUCED BY THE ACTUAL WHEEL LOADS OF COOPER'S "A," "EXTRA HEAVY A" AND LEHIGH VALLEY "HEAVY GRADE" LOCOMOTIVES.

EXPERIMENTS TO DETERMINE THE EFFECT OF BEDDING UPON THE STRENGTH OF MARBLE.*

It is well recognized that it is very difficult to obtain uniform results in testing specimens of stone in compression, even when great care is exercised in preparing the specimens and in placing them in the testing machine. This is due mainly to the inability of workmen to make the bearing faces of the specimens true parallel planes without special machinery or great expense. For commercial purposes it is necessary that some means be devised by which reliable results can be obtained with specimens formed by tools and machinery usually found at stoneworks of any considerable magnitude, so that the engineer may obtain a definite knowledge of the strength of the stone in compression which he intends to use, without going to great expense and consuming much time. This does not necessarily mean that the results of the experiments shall represent the strength of the material in large pieces as used in engineering structures, but that they shall represent the comparative strength of the material, some well known homogeneous stone being taken as a standard.

If specimens are formed by ordinary tools and machinery the faces will usually have ridges and high points and are seldom parallel; and when such a specimen is placed in the testing machine it will first take the applied load on the high points and ridges. As the pressure is increased these will be crushed down and the specimen fails by being wedged apart, if the term wedge may be applied to the portions of the specimen which have the maximum loads. The specimens may be artificially "trued up" in several ways, the most common way being, perhaps, to cover the bearing faces with plaster of paris which can be either cast so as to present true parallel planes or ground to such a state. Another method is to place between the bearing faces of the specimen and the faces of the testing machine some material which will, or rather is supposed to, conform to the irregularities of the specimen and distribute the applied load uniformly over the bearing faces. Sheet lead, sole leather and pine have been applied for this purpose, but as far as the writer is informed none of them has been used to any great extent.

In order to determine, if possible, something about the effect of bedding upon the results of compression tests and also their reliability, the writer had a series of specimens prepared at a marble quarry in Iowa under the following specifications: (1) Specimens to have square bases and a height equal to 1½ the side of the base. (2) For any particular grade of stone the specimens representing that grade to be cut from the same piece of stone. (3) Specimens to be cut so that the natural bed of the stone would form the square bases.

The specimens were cut by ordinary tools and machinery. Five grades of stone were represented by the specimens, which were of two sizes, one set being 3 × 3 × 4½ ins. and the other 2 × 2 × 3 ins.

The writer decided to try five kinds of bedding material, namely, cast iron, soft pine, sole leather, sheet lead and tar board. Plaster of paris was not tried, owing to the unknown effect of the moisture necessarily absorbed by the stone and the undesirability of using such a material in commercial work. The cast iron employed was in the shape of a rectangular block having true and parallel bearing faces. The soft pine was in thoroughly seasoned pieces about 4 × 9 × ¼ in. The sole leather was perfectly dry and the pieces were just a little larger than the bearing face of the specimen. The sheet lead was in pieces 4 × 4 ins., as were also the pieces of tar board. In each case one piece of bedding material was used on each bearing face of the specimen and in no case was any piece used twice.

As the pieces were tested they were carefully measured, two measurements being made to determine the area of each bearing face and four to determine the distance between these faces. The specimens were also examined for chips, cracks, ridges, high points, etc. In placing the specimens in the testing machine care was exercised to have the plates transmitting the pressure gear as nearly as possible over the entire face of the specimens by means of thin iron wedges. In case the faces were parallel no wedges were employed. These specimens were closely watched for the first crack or signs of failure. In all cases the load was slowly applied. (The results of the tests are published in detail in tabular form. We omit these tables, but give the summary of the tests made by the author.—Ed.)

Cast Iron Bed.—Out of 26 specimens six cracked before the maximum load was reached, and 14 out of 24 failures left two pyramids. The average results stand fifth in magnitude. These results indicate that the specimens were tested under very nearly the same conditions, and also that the specimens were not sufficiently true to give reliable results, as about 40% of the failures indicate a non-uniformity in the application of the pressure by failing in pieces wedged-shaped, etc., instead of pyramids.

Soft Pine Bed.—Only two specimens out of 17 cracked before the maximum load was applied, but in only five cases were two pyramids obtained, the specimens having a tendency to split on lines parallel with the grain of the pine. The specimens usually compressed the pine about ⅛ in., and hence were confined at the edges, which, wit hthe more uniform distribution of edges, which, with the more uniform distribution of creased magnitude of the results obtained. The results stand, third:

Sole Leather Bed.—Three specimens out of nine cracked before failure, and three specimens left two pyramids; the remaining specimens left wedges or small pieces. The specimens compressed the leather a little, which evidently caused them to be confined slightly at the edges. The leather probably had a tendency to distribute the pressure over the face of the specimen, but evidently this distribution was not uniform, as only three of the specimens left two pyramids. This may possibly be explained by the fact that the sole leather was not uniform in thickness, commercial leather being employed. The results obtained stand second in magnitude.

Sheet Lead Bed.—Here no specimens cracked before receiving the maximum load, and eight out of ten specimens left two pyramids. The load was uniform in thickness, and after the experiment was but slightly compressed. The indications are that the lead distributed the pressure very evenly but lowered the magnitude of the results, probably by flowing into the specimen and wedging it apart. The results stand fourth in magnitude.

Tar Board Bed.—Three specimens out of 15 cracked before receiving the maximum load, and ten out of 15 left two pyramids. The tar board was of uniform thickness and slightly compressed after the experiment. The specimen was probably confined somewhat at the edges. The results stand first in magnitude, which is probably due somewhat to the confining action of the tar board and to the even distribution of the pressure applied.

Conclusions.—In conclusion it appears to the writer that to obtain the best idea of the comparative strengths of specimens of different kinds of stone, the specimens should be cut with perfectly parallel plane ends and tested between parallel iron or steel plates. But this calls for great labor and expense in preparing the specimens, so that some kind of bedding material seems desirable. Of those tried, sheet lead seems to distribute the pressure the best, but lowers the strength of the specimens by an unknown amount, depending upon the structure of the material. Pine is undesirable, owing to its splitting action. Sole leather answers very well, but has the objection of not being uniform in thickness. Tar board distributes the pressure very well, does not flow into the specimen, has no splitting action, but raises the strength of the specimen by confining the ends, yet, in spite of the latter defect, the writer believes for commercial testing or comparative tests that it is the most reliable of the five kinds of bedding material tried. This conclusion is based upon but 80 experiments; but a careful examination of the detailed results shows that the specimens were practically uniform in respect to the char-

*Abstract of a paper prepared for the Indiana Engineering Society, by Malvred A. Howe, Professor of Civil Engineering, Rose Polytechnic Institute, and to be published complete in the "Journal" of the society.

acteristics of their end faces, and as each grade was cut from the same piece of stone it is believed the conclusion is warranted.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Validity of Assessments on Abutting Owners for Public Improvements.

A city charter giving power to improve streets at the expense of adjoining property is not unconstitutional, as depriving persons of property without due process of law, because it does not expressly provide for notice to the property owners at any stage of the proceedings. Under a city charter making each lot or part liable in whole or in part for the cost, as the council may determine, of an improvement on the half street, in front thereof, and providing that the council may assess on each lot or part thereof, liable for its proportionate share of said cost, it is proper to make an assessment by the front foot. An abutting property owner, with actual knowledge that the work is being done, cannot wait till the completion to object to the method of assessment or other irregularities in the action of the city council, which do not affect their jurisdiction.—Wilson v. City of Salem, Sup. Crt. of Ore., 34 N. E. Rep., 9.

Assessments for Public Improvements.

In an action by an assignee to enforce an assessment for a public improvement, which was against a certain lot, but to an unknown owner, the fact that the assignment, which describes the lot, also states that the assessment was to a certain person as owner, does not render it inadmissible, as the name of the alleged owner may be rejected as surplusage. The lien of an assessment for a public improvement is merely an incident of the demand, and passes with an assignment therefor.—Gill v. Dunham, Sup. Crt. of Cal., 34 Pac. Rep., 69

Liability for Street Assessments.

The statutes of 1889 provide that where any work is done, on either or both sides of the center line of any street for the distance of one block or less, and further work opposite to the work of the same class already done, is ordered to be done to complete the unimproved portion of said street, the assessment to cover the total expense of said work so ordered, shall be made upon lots or portions of the lots only fronting the portion of the work so ordered. Where a street was ordered to be paved for one block, where not already so paved, the assessment was properly made on those lots only, on which the work done abutted.—McDonald v. Conniff, Sup. Crt of Cal., 34, Pac. Rep., 71.

Liability of Water Companies for Insufficient Supply of Water.

A provision in the ordinance of a city granting a franchise to supply water to the city, requiring that the grantee shall constantly, day and night (except in case of an unavoidable accident) keep all fire hydrants supplied with water for instant service, and shall keep them in good order and efficiency, did not confer upon the owner of property destroyed by fire a right of action against said grantee, on account of its failure to furnish water as stipulated, although thereby the loss by such fire would have been obviated. Under such circumstances the grantee is not liable by reason of assuming the functions which might properly belong to the city, for the reason that under the facts stated, the city, if performing the same functions, would not be liable.—Eaton v. Fairbury Water Works Co., Sup. Ct. of Neb., 56 N. W. Rep., 201.

Sewerage Assessments in Municipal Improvements.

Under a village charter providing that any persons dissatisfied with the decision of the bailiffs, as to the assessment for contribution for the building of a sewer, may petition the county court for reassessment, the court has the right to determine the right of the bailiffs to make any assessment. A village charter provided that every person whose drain entered into a common sewer should be assessed for the cost of its construction. Petitioner's grantor had paid his share of the construction of a private sewer, which was afterward conveyed, without consideration, to the village. Petitioner was not liable to an assessment, when it became necessary to lower the sewer in order to connect it with another sewer constructed to drain another distinct territory.—Boyden v. Village of Brattleboro, Sup. Ct. of Vt., 27 At. Rep., 164.

Assessments for Street Improvements.

Where the statute provides that when the cost of any streetwork ordered by the city council, and chargeable against any lots, shall exceed one-half of their assessed value, the excess shall be paid by the city. Section 7 of the same statute provides the manner of assessment and declares that whenever the said assessment on any lot would exceed one-half of the valuation, then the assessment shall only be one-half. Section 26 provides that, whenever the city council orders any work done, it shall be deemed to have ordered the payment out of its treasury of the excess of any assessment for said work, otherwise chargeable on any lot, over one-half the valuation of the lot. A lot was not limited to an assessment, in a single year, of half its value, but this limitation applied only to an assessment for the work, included in a single resolution.—Warren v. Postal, Sup. Ct. of California, 33 Pac. Rep., 930.

PERSONALS.

Mr. J. B. Wilcox has been appointed Chief Engineer of the Columbus, Shawnee & Hocking Valley Ry.

Mr. Harry H. Rogers has been appointed City Engineer of Anderson, Ind., vice Mr. E. M. Culp, resigned.

Mr. A. J. McCabe has resigned his position as Superintendent of the Cascade Division of the Great Northern Ry.

Mr. Willard D. Sanborn has been appointed Superintendent of Water-Works at Dover, N. H., vice the late Mr. W. D. Taylor.

Mr. Carroll Ph. Bassett gave a lecture on "Sewage Disposal in Inland Towns" to the students of the University of the City of New York, on Feb. 14.

Mr. Warren Nickerson has been appointed Chief Engineer of the Wiscassett & Quebec Ry., in Maine, and will make preparations for commencing construction shortly.

Mr. George N. Walker, Resident Engineer of the Jacksonville Southeastern R. R., with office at Jacksonville, Ill., has resigned, and the position has been abolished.

Capt. A. H. Mattox has been appointed General Manager of the Washington & Chesapeake Beach Ry. Co., now building a railway from Washington, D. C., to a new seaside resort.

Mr. W. B. Comer, a contractor on the Chicago drainage canal, was killed instantly by a dynamite explosion at Lockport, Ill. He was at one time engaged on the construction of the Cincinnati Southern Ry.

Mr. John V. B. Rapp, formerly Chief Engineer for Milliken Brothers, has resigned to take a similar position with the Hay Foundry & Iron Works, of Newark, N. J., and will make his headquarters at the New York office, 45 Broadway.

Mr. H. W. Reed, President of the Roadmasters' Association of America, has resigned his position as Master of Roadway of the Savannah, Florida & Western Ry., to accept a position with a banking company at Brunswick, Ga.

Mr. Albert Millet, a member of the engineering and contracting firm of Millet & Coiret, Guayaquil, U. S. of Colombia, died Dec. 10 at Panama on his way to New York on a business trip. The firm completed its contract for water-works at Guayaquil about a year ago.

Mr. William P. Watson has been appointed Surveyor-General of Washington. In 1890 he was Principal Assistant Engineer of the Seattle & Montana R. R., and in 1893 had charge of the surveys and estimates for the U. S. Commission for the improvement of the Columbia River at The Dalles, Ore.

Mr. William H. Lotz, M. Am. Soc. C. E., died in Chicago recently. He was born in Germany Oct. 31, 1837, and had lived in Chicago since 1865. When he came to this country he went to Richmond, Va., and during the war had charge of the ordnance department of the Confederacy. He was the designer of and superintended the constructon of the first iron furnace at Birmingham, Ala.

Mr. J. Elfreth Watkins, Assoc. Am. Soc. C. E., has resigned his position as Curator of the Department of Transportation in the National Museum at Washington, D. C., to accept that of Director of the Department of Industrial and Mechanic Art in the new Columbian Museum at Chicago. Mr. Watkins was in charge of the Pennsylvania R. R. Co.'s extensive exhibit at the World's Columbian Exposition.

Maj. James O. Moore, formerly an engineer on the Baltimore & Ohio R. R., died at Hancock, Md., Feb. 2. He was for a long time Right of Way Agent on the Philadelphia Division. He built the Port Royal R. R., from Augusta to Port Royal, and the Fairmont, Morgantown & Pittsburg R. R., as well as the Grafton and Belington branches of the Baltimore & Ohio R. R. He also planned and carried out improvements at Harper's Ferry.

Mr. Abraham Gottlieb, of Chicago, died suddenly Feb. 9, at the age of 56. He was born in Bohemia and came to this country in 1866. He had large experience in bridge building, and was Consulting Engineer for the World's Columbian Exposition during the early part of its construction. He was connected with the building of the Administration and Fine Arts buildings at the Exposition, and with that of the Masonic Temple, and at the time of his death was representative of the Mount Vernon Bridge Works.

Mr. L. Schofield, who died Feb. 5 at his home near Chattanooga, Tenn., aged 80, is said to have been the first man to make iron rails in the South. He was born in England, emigrated to America and was associated with Peter Cooper and Abraham S. Hewitt, of New York, in the firm of Cooper, Hewitt & Co., Trenton, N. J. In 1852 he engaged in the rolling mill business in Michigan, and in 1859 moved to Atlanta, Ga., where he made much of the armor used in constructing cruisers for the Confederate navy.

NEW PUBLICATIONS.

BASSICK CONTACT GOLD & SILVER MINING & MILLING CO., of Silver Cliff, Colo. Prospectus, with engineer's report and map; 8vo; pp. 27.

The report made by Mr. Carl Wulsten, mining engineer, on the geology and development of the company's mines gives the following figures for wages and supplies at the mines: Timber, $4 per load of 12 pieces for shaft timbers; firewood, $3 per cord; coal, $8 per ton; labor, shaft sinking and drifting, $3 per day; top laborers, $2.50 per day; enginemen, $3 and $4.50 per shift of 8 or 12 hours.

STATE LAWS RELATING TO THE MANAGEMENT OF ROADS.—Enacted in 1888-93. Compiled by Roy Stone, Special Agent in Charge of Road Inquiry. Bulletin No. 1. Washington, D. C.: U. S. Department of Agriculture. 8vo; pp. 95.

This publication is Bulletin No. 1, issued by the special agent in charge of the Road Inquiry Office. It is useful, as giving the full text of the road laws enacted since highway improvement in the United States has taken a definite shape; and while some of them are crude enough, the general tendency is to go about this work in a much more intelligent and scientific manner than formerly. As a rule road construction is to be done by contract under competent engineering supervision, instead of being carried out by the wasteful and inefficient method of "Working out" the road tax. As yet, nearly every state differs in the form of the body controlling road improvement, and in the method of selecting this authority; though the old-time board of county commissioners, acting also as road supervisors, seems to prevail. But one state, Massachusetts, has, as yet, a permanent state highway commission, empowered to not only carfully study and recommend improved methods, but also to carry its recommendations into effect. A beginning, however, has been made in 14 states in the form of new and at least better road laws than were formerly in force, and the movement to improve the highways is a live interest in all the states. The campaign of education in road improvement and the necessity for it are now on, and the Office of Road Inquiry at Washington can do much by the publication of these bulletins in advancing the era of actual work.

RECLAMATION OF THE ARID LANDS OF WYOMING.—Address before the Cheyenne Chamber of Commerce, Jan. 16, 1894, by Elwood Mead, State Engineer. Cheyenne Chamber of Commerce, Paper; pp. 16.

This address presents the status of irrigation in Wyoming and contains suggestions for its further development, including the retention of land and water under the same control and a well-studied general plan for irrigation works to be carried out under state supervision.

GERMICIDAL EFFICIENCY TESTS OF A DISINFECTANT FOR USE IN RAILWAY SANITATION. —By W. T. Sedgwick, Ph. D., Professor of Biology, Massachusetts Institute of Technology. Reprinted from the Technology Quarterly; Vol. VI., No. 2, July, 1893. Paper; pp. 23.

The disinfectant tested was that one made and used by the Pennsylvania Railroad Co. The pamphlet describes the disinfectant and its use and describes the experiments which were made upon its efficiency. The results made a favorable showing for the disinfectant.

THE CINCINNATI SOUTHERN RAILWAY.—A Study in Municipal Activity. By J. H. Hollander, Fellow in Economics, Johns Hopkins University. Studies in Historical and Political Science. Herbert B. Adams, Editor. Baltimore: The Johns Hopkins Press; 8vo., paper; pp. 96; $1.

This is an interesting and well written account of the construction by the city of Cincinnati of the Cincinnati Southern Ry. from Cincinnati to Chattanooga, a distance of 336 miles, at a cost of over $18,000,000. The road was not put in operation throughout its entire length until 1880, although its construction was authorized in 1869, and the first contract was awarded on Dec. 12, 1873. The city has never operated the road, but leased the roadbed and terminal facilities to a company from the start.

CLARKE'S POCKET-BOOK FOR PLUMBERS, ARCHITECTS, SANITARY ENGINEERS, ETC.—A collection of Tables and Memoranda calculated and compiled by J. Wright Clarke, Plumber, Author of "Plumbing Practice," and Electrical Tables and Memoranda by W. Hibbert, A. I. E. E., F. C. I. London: R. J. Bush & Co. 32mo; 265 pp.; limp morocco; 1s. 6d.

This little vest pocket set of tables is in great part made up of new matter especially intended for the use of plumbers, architects and sanitary and electrical engineers. Mr. Clarke was instructor in plumbing in the London Polytechnic and he has here selected such material as experience had taught him was most useful to his fellow-workmen in the regular line of business. Space forbids even touching upon its contents; but for the purpose intended it is certainly a most useful little pocket-book of rules and tables of all kinds pertaining to the arts specified. American purchasers may obtain copies of the book from "The Engineering Record" of this city.

ATLAS MEMORANDUM AND REFERENCE BOOK.—The Repauno Chemical Co., Wilmington, Del.; 12mo; pp. 163.

This is another of those convenient modern publications which, primarily intended to promote private business interests, do so by serving the convenience of engineers and possible customers. It contains a compilation of formulas and tables relating to civil and mechanical engineering, and especially to the use of explosives and rockwork, with an included memor-

andum book, all in convenient shape for the pocket. Much of the information contained in it is not to be found in other like publications.

WHAT AN ENGINEER SHOULD KNOW ABOUT ELECTRICITY.—By Albert L. Clough. New York: Mason Regulator Co. 12mo; pp. 108; illustrated; 50 cts.

This little book contains much useful information as to the operation of lighting and power plants, with descriptions of the machinery and instructions for care of dynamos, etc. There are also the rules and requirements of the Underwriters' International Electric Association for the installation of electric light and power.

LOCOMOTIVES.—Societe Suisse pour la Construction de Locomotives et de Machines. Winterthur, Switzerland. 4to; cloth; 34 plates.

This is a handsome illustrated catalogue consisting of 34 half-tone plates of views and various types of locomotives, with the principal dimensions in each case. There are eight-wheel and mogul engines, and a Forney engine for the Finland State Railways. There are numerous tank engines, ranging from four-wheeled engines (one of which is driven by a vertical rocking lever connected to the piston rod and connecting rod) to eight-wheel and mogul engines. Tenders are small, and generally on four wheels. All the engines have outside cylinders, and the majority have outside valve gear also, while the Westinghouse brake is fitted to many. Several of the engines are two-cylinder compounds. The rods appear to be of very light section, a feature which was particularly noticeable on the foreign locomotives at the Columbian Exposition. The works make a specialty of steam dummy engines for tramways and local railways, and also of engines for rack railways. Among the latter are illustrated engines for Abt and Marsh (or Riggenbach) rack rail systems, and the horizontal rack rail system employed on the Mount Pilatus Railway. This latter engine has the boiler set transversely to the track. Among engines built by these works and illustrated in our columns are one for the Briens & Rothhorn Rack Railway (Eng. News, Dec. 15, 1892) and an eight-wheel compound express engine for the Jura-Simplon Railway. Eng. News, March 9, 1893).

TRADE PUBLICATIONS.

THE CARSON TRENCH MACHINE.—For Excavating and Refilling All Kinds of Trenches. Carson Trench Machine Co., 16 Dorrance St., Charlestown, Boston. Paper; pp. 87; illustrations.

This pamphlet gives a good idea of the work that may be performed by the well known Carson trench machine. Most of the illustrations are from photographic views of the machine in operation under different conditions.

CAST IRON PIPE.—For Water and Gas, Sewers, Culverts and Drains, Bell and Spigot or Flanges; Fittings or Special Castings, Fire Hydrants, Gate Valves, Lampposts, etc. General Foundry and Machine Works, Reading Foundry Co., Ltd., Reading, Pa. Paper; pp. 38; tables and illustrations.

This is a descriptive catalogue and price list and contains a number of useful tables.

POWER PUMPS.—For Paper Mills, Ground Wood Pulp Mills and Sulphite Pulp Mills and other Industries Requiring Power Pumps. Knowles Steam Pump Works. New York: paper; pp. 31.

This illustrated catalogue describes various kinds of power pumps, giving sizes, dimensions and capacities.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The spring meeting of the society is to be held at Montreal, P. Q., beginning Tuesday, June 5. Applications for membership and papers to be read at the meeting are requested to be forwarded to the secretary by the first week in April.

TECHNICAL SOCIETY OF THE PACIFIC COAST.—At the annual election on Jan. 19 officers were elected as follows: President, C. E. Grunsky; Vice-President, Geo. W. Dickie; Secretary, Otto von Geldern; Treasurer, W. C. Ralston; Directors, Frank Soule, W. F. C. Hasson, Geo. E. Dow, Henry S. Wood and J. Ch. H. Stut.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Feb. 8 Mr. Desmond FitzGerald read a paper on "A Concrete Lined Water-Works Tunnel," an abstract of which we published last week. The work was done by the city, and there was some discussion as to the relative merits of having such work done by contractors or engineers. The secretary announced the following deaths: Members, Lewis A. Smith, Jan. 5; Gorham P. Low, Jan. 8; William H. Lotz, Jan. 31; Associate, George H. Ely, Jan. 24.

ENGINEERS' CLUB OF PHILADELPHIA.—Meeting of Feb. 3, President John C. Trautwine in the chair; 52 members and visitors present. Mr. Edward K. Lands read a paper upon the "Magnetic Concentration of Iron Ores," calling attention to the fact that though known for some time, and actually used in 1852, it is commercially a new process. Mr. Landes then described the process generally and pointed out the gain in the increased output and regular work of the furnace from the constant composition of the ore. Mr. John Birkinbine said that no less than 150 patents had been taken out in this country for magnetic separation, though only 5 or 6 were of commercial value. He believed that the better the plant the better were the chances for success in this process. Messrs. C. T. Thompson and Henry G. Morris joined in the discussion.

L. F. Rondinella, Secretary.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Feb. 7 Prof. J. B. Johnson described the testing laboratory of Washington University, where an extensive series of timber tests is now in progress under the auspices of the Forestry Division of the Department of Agriculture. Afterward the meeting adjourned to the laboratory, where cross-breaking tests were made on yellow pine beams 4 × 4 ins. and 8 × 14 ins., and a compression test on a yellow pine column 10 ins. square and 12 ft. long.

Wm. H. Bryan, Secy.

WESTERN SOCIETY OF ENGINEERS.—At the meeting on Feb. 7 the proposed reorganization of the club was discussed by Messrs. Chas. Hansel, E. L. Corthell, W. R. Roney, John F. Wallace, L. E. Cooley and others. A committee of eight was appointed to investigate the question and report at the next meeting on the best plan to pursue in reorganization. The paper of the evening was by Edwin Pynchon, M. D., on the "Use of High Explosives in Aerial Navigation." The author proposed to propel aeroplanes by the reaction due to successive explosions of small charges of dynamite.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—A monthly meeting for informal discussion was held Jan. 17, Mr. J. C. Bawn, Vice-President, in the chair. The subject for the evening was "Railway Signaling," opened by Mr. C. S. Churchill, who described the various forms and systems in use both for interlocking and blocking, including the electric train staff system, the Mozier system, the Sykes block (controlled manual), the Westinghouse pneumatic automatic block and pneumatic interlocking, and the Hall electric automatic block. The methods of operating and the circumstances and conditions under which each system is best applicable were described. Mr. R. H. Soule gave an interesting description of the beginning of interlocked signaling on the Pennsylvania R. R. in 1874, and his connection with the installation of several plants on that road in preparation for the Centennial travel in 1876.

The annual meeting was held Jan. 31 and Feb. 3, the President, Mr. Chas. S. Churchill, in the chair, with 15 members present. The directors reported a membership of 86. Officers were elected as follows: President, Chas. S. Churchill; Vice-President, W. H. Adams; Directors, J. B. Fuller, H. A. Gillis and Wm. Dunlap; Treasurer, J. R. Schick; Secretary, Jno. A. Pilcher.

Mr. Churchill presented the report of the Committee on "Regulations Governing the Erection of Buildings." The committee had presented these regulations to the City Council of Roanoke and later to the Council Committee on Ordinances, who accepted them and propose to recommend them for adoption as a building law for the city of Roanoke at next Council meeting. Mr. Coleman presented the report of the Committee on "State Laws for Public Roads," which, after being taken up by sections and discussed, was adopted with slight amendments, and a committee was appointed to take the proper steps to bring the proposed law before the State Legislature. A paper was then read by Mr. Rene de Saussure on "Graphical Methods," and the monthly meetings and subjects were announced as follows: Feb. 28, "Bridging the Hudson River," Chas C. Wentworth; March 21, "Blast Furnace Construction," Rubens Patterson; April 18, "Aluminum Alloys," Samuel Wallis; May 16, "Boiler Construction," G. R. Henderson.

Jno. A. Pilcher, Secy.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—At the meeting on Feb. 5 Mr. C. A. Hunt explained the repairs now in progress on the dam at St. Anthony's Falls. Mr. Hilgard gave his theory of the failure of a portion of the roof of the St. P. & N. P. tunnel at Westminster St. The tunnel has a clear width of 28 ft., and in that part under consideration was quite flatly arched with four concentric rings of brick at the crown instead of five, as provided by its designer after brick had been ordered to be substituted in this section in place of cut stone used in other sections of the tunnel. In the course of seven years the arch at the under side of crown had settled about one foot and a cross-section of the intrados showed a slightly sinuous line. Careful inspection failed to prove any definitely measurable displacement or settlement of the vertical side walls. In settling, the brick rings separated from one to three inches as near as might be on the line of greatest pressure and but slightly elsewhere. For instance, at the crown, the greatest open space had formed immediately below the external, and at haunches above the internal, ring. The passage of this line of principal separation through intermediate rings in offsets corresponding to the radial joints, was marked by longitudinal cracks. In the author's opinion the settling of the arch was due to the gradual grinding out of mortar from both ring and radial joints effected by the vibration of the roof and the general jarring caused by the frequent passing of weighty trains pulling through the tunnel on a heavy grade (traffic continuing through the tunnel during its construction).

Furthermore, this section of the arch, although resting on heavier sidewalls than those supporting the stone arch, lacked the lateral support and surcharge of the contemplated filling which had been indefinitely postponed by the rival railway corporation owning the ground crossed and which had insisted on the building of the tunnel entirely across its right of way through the Trout Brook hollow. The weight and bulk of this fill if made would have considerably checked the vibrations. Mr. Hilgard suggested that the lesson taught by this case was, that for similar arches under like conditions cut stone should be used instead of brick. Should brick be a necessary resort, cut stone blocks should be inserted at proper intervals to form a bond between the several rings. He further urged that arches exposed to vibration and jarring should be built considerably heavier than the load alone would require.

Mr. Munster followed with a few remarks on the measurement of water in connection with the test of a pumping engine of 6,000,000 gallons capacity, and showed a diagram for weir measurements, giving quantities in cubic feet per second from gage readings for weirs up to 10 ft. in length. The president, Mr. Wilson, then produced some topographical maps of the Connecticut state survey.

C. L. Annan, Secy.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 17. Secy., L. F. Rondinella, 1122 Girard St.

SWEDISH ENGINEERS' CLUB.
Feb. 17. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.

ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 19. Secy., E. Nexsen, 504 Kasota Block.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 19, 23. Virginia Beach, Va. Secy., R. W. Raymond, 13 Burling Slip, New York.

ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Feb. 20. Secy., R. H. Clark, Pittsburg.

WESTERN RAILWAY CLUB.
Feb. 20. Secy., Clement F. Street, Rookery, Chicago.

COLUMBIAN ENGINEERING SOCIETY.
Feb. 20. Secy., F. W. Hart, Washington, D. C.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 21. Secy., S. E. Tinkham, 36 Bromfield St.

ENGINEERS' CLUB OF ST. LOUIS.
Feb. 21. Secy., Wm. H. Bryan, Turner Bldg.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb 21. Secy., F. Collingwood, 127 E. 23d St., New York.

DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 27. Secy., F. E. King, Jacobson Block.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Feb. 28. Secy., J. A. Pilcher, Roanoke, Va.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
March 2. Secy., E. K. Smoot, 803 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 2. Secy., O. Von Geldern, 719 Market St., San Francisco.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 5. Secy., C. L. Annan, City Engineer's Office.

ENGINEERS' SOCIETY OF PHOENIXVILLE.
March 6. Secy., W. Halliburton.

WESTERN SOCIETY OF ENGINEERS.
March 7. Secy., J. W. Weston, Lakeside Bldg., Chicago.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
March 8. Secy., C. H. McLeod, Montreal, P. Q.

ENGINEERING ASSOCIATION OF THE SOUTH.
March 8. Secy., Hunter McDonald, Nashville, Tenn.

ENGINEERS' AND ARCH'TS CLUB OF LOUISVILLE.
March 8. Secy., F. W. Mowbray, Norton Building.

MONTANA SOCIETY OF CIVIL ENGINEERS.
March 10. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
March 12. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
March 12. Secy., M. F. Schinke, City Hall, Milwaukee.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 13. Secy., F. C. Osborn, Case Library Building.

NORTHWEST RAILROAD CLUB.
March 13. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
March 13. Secy., D. W. McMorris, Burke Block, Seattle, Wash.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
March 14. Wichita, Kan.

NEW ENGLAND RAILROAD CLUB.
March 14. Secy., F. M. Curtis, P. O. Box 1576, Boston.

AMERICAN SOC. OF MECHANICAL ENGINEERS.
March 14. Secy., F. R. Hutton, 12 W. 31st St., New York.

ENGINEERS' CLUB OF CINCINNATI.
March 15. J. F. Wilson, 24 W. 4th St.

NEW YORK RAILROAD CLUB.
March 15. Secy., John A. Hill, Temple Court.

SCANDINAVIAN ENGINEERING SOC. OF CHICAGO.
March 15. Secy., Howard Berge, 100 Washington St.

TACOMA SOC. OF ENGINEERS AND ARCHITECTS.
March 16. 201 Washington Building.

NORTHWESTERN TRACK AND BRIDGE ASS'N.
March 16. Secy., D. W. Meeker, St. Paul.

CENTRAL RAILWAY CLUB.
March 28. Secy., S. W. Spear, Buffalo, N. Y.

AMERICAN RAILWAY ASSOCIATION.
April 11. Secy., W. F. Allen, 24 Park Place, New York.

SOUTHERN & SOUTHWESTERN RAILWAY CLUB.
April 19. Secy., S. A. Charpior, Macon, Ga.

MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.

MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

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AND

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

In the interest of members of the American Society of Civil Engineers who prepare their own copies of Society publications for binding, we would respectfully protest against the wire-binders, lately adopted for the monthly issues. The Transactions and Proceedings are separately paged and they must be divided and properly assembled for binding; and this must be done by the owner if he would insure against blunders by the binder. With the linen thread, until lately employed, a knife was all that was required; but with the flat wire-binder now used, mutilation of the outer pages almost necessarily accompanies even the most careful attempt to separate the parts. The temper of the operator is also very apt to be among the things mutilated. If the publication committee will see to this seemingly trifling change in form and material, it will earn the hearty thanks of every member of the Society whom we have thus far interviewed.

If the Washington correspondent of the New York "Sun" is to be credited, Congressman Geary, of the Committee on Commerce, has something yet to learn concerning the "development of engineering science"; though he says he has learned "a good many interesting things" on this head since his committee has had to do with the New York Bridge bill. Mr. Geary is quoted as declaring that until the East River bridge was built it was not supposed that " a steel wire could be made of sufficient tensile strength to hold together for a distance of 1,600 ft.," and that "all wire previously made had parted of its own weight at that length." He goes on to say that Mr. Roebling, though "he was laughed at by other engineers," demonstrated that a 1,600-ft. span was possible; and the further piece of real news is imparted to engineers that "since then the Firth of Forth Bridge has been built with wires 1,700 ft. long," and "a wire can now be made of 2,100 ft. and strung from one point to another without breaking." There is just enough truth in the quoted statement to make the "little knowledge" a dangerous thing for Mr. Geary to handle; especially when he substitutes suspended wires for arched tubes in the Forth bridge. The reporter either got "mixed," or Congressman Geary ought to learn a few "more things" about suspension bridges before he allows himself to be interviewed on that head. One is strongly reminded of Josh Billings' often-quoted remark: "It is better not to know so many things than to know so many things that are not so.

It may be of interest to note in this connection that as a matter of fact the strongest steel wire now made would support its own weight if stretched across a chasm about 17 miles wide, assuming a deflection equal to one-half the span.

The Greater New York bill has passed the Assembly by an almost unanimous vote and the probability is that it will become a law and the residents of the area affected will have an opportunity to express their views by ballot. The bill provides for two ballots only, one for and one against consolidation; the purpose of the framers of the bill being to first ascertain the views of the majority on this one head and to leave to future legislation all questions of detailed plan of government. The fact was made apparent in the speeches against the bill that some of the smaller communities, which are now out of debt, are naturally opposed to consolidation and a share in the burdens of other communities not so fortunate. But a little thought will probably convince this opposing element that the advantages of sharing in the general improvement that must result from a consolidation of great and widely spread interests will more than compensate for a slight increase in taxation. As this journal has before set forth, this movement for a Greater New York is a demand of radically changed conditions and is in the interest of better government. While the proposed increase in area and population would doubtless be popular with many patriotic citizens, this mere increase is of sentimental and fictitious value as compared with the consolidation of common interests and the more direct and intelligent application of a common fund to a common good. The problem of best governing this Greater New York will be an interesting one; but it has been solved in even larger communities and will work itself out in time.

The phenomenal progress made by the Southern States in agricultural and industrial pursuits in the last two decades or less is well brought out in the statistics presented at the late annual banquet of the Baltimore Merchants' and Manufacturers' Association. When it is taken into consideration that the "reconstruction period" only came to an end in 1877 and adverse political conditions interfered with decided progress previous to that time, there can be no doubt that the South has kept well abreast of the general advance in the United States in the period under consideration. The value of the annual yield of cotton is now about $300,000,000, and in 27 years the Cotton States have added $9,000,000,000 to the aggregate wealth of the nation. The timber supply is practically yet untouched, though it covers over 207,000,000 acres according to the last census report. But it is in mining, an almost unknown industry "before the war," that the South has made the most marked progress, and in the states of Virginia, Tennessee, North Carolina, Georgia, Alabama and Kentucky the juxtaposition of iron and coal causes those familiar with the subject to predict that in the near future these states will rank with the most successful iron and steel producing districts of like area in the world. While the whole United States only mined 15,000,000 tons of bituminous coal in 1870, in 1890 the South alone produced nearly 18,000,000 tons. In 1870 the United States mined 3,163,839 tons of iron ore; and in 1890, the South produced 2,917,529. In 20 establishments in the South the cost of manufacturing iron is reported at from $8.55 to $12.50 per ton; while 70 establishments in the North figure this cost at from $12 to $20 per ton. The South is not only growing cotton, but it is also spinning it into cloth to the extent of over $61,000,000 invested in factories in 1890, and consuming 600,000 bales of cotton in this industry. And in 1893 744,000 bales were so consumed. It is estimated that the phosphate deposits in South Carolina and Florida will in time yield a greater value than the whole gold output of California to date, or about $150,000,000, and other figures of like significance were brought forward to prove the wonderful resources and phenomenal late development of the Southern States. While Northern capital and Northern men have assisted greatly in this development, it is evidently an investment profitable to all concerned and the whole country is to be congratulated on its results.

According to the glowing prospectus which we publish in another column, engineers who have these many years been repelling the attacks of the teredo on pile structures by cresoting, sheathing and other devices known to the profession, might have saved all their trouble by merely substituting for their wooden piles an "indestructible pile," which may be described with fair accuracy as a row of paving blocks strung on a gas pipe. Strangely enough, however, engineers generally have remained ignorant of this beautifully simple idea; and now (if we may accept the statements of the prospectus in another column), they will have to pay a royalty of $5 each for every pile constructed in this manner. It is probably unnecessary to point out to our readers the merits of this system of construction in the full detail which it really deserves. The graphic claims of the prospectus, the still more graphic illustration of a railway trestle constructed on this plan, with its truly remarkable appearance as to lateral stability, must impress every engineer; and even the non-professional reader, if he be of ordinary intelligence, cannot fail to form a clear idea as to the merits of the invention.

We have often referred to the prestige which an engineer gains by membership in some of the national engineering societies; and those who read the prospectus carefully cannot fail to notice the prominence with which the fact is displayed that the inventor of the pile (who is also consulting engineer to the company and author of the "report" on the strength of which subscriptions to stock are invited) is a member of the American Society of Civil Engineers.

This report, which is said to "command the respect and attention of the engineering world," predicts that the company's stock "will be worth at least three times its par value of $100 per share." It is now offered at the ridiculously low price, as the auctioneers say, of $20 per share. We fear that the hard times of the past season have left many engineers without the requisite $20; so by way of consolation we will refer them to a paper read by Mr. Wm. H. Searles (Trans. Am. Soc. C. E., Vol. VIII., p. 238), and also to U. S. Patent No. 178,438, which was issued to Chas. E. Hill, of Brooklyn, N. Y., June 6, 1876, for a "composite pier," and which, therefore, expired six months ago. Mr. Searles' paper described a pier formed of blocks of stone piled one on top of another and having a hole bored through them for the insertion of a continuous steel rod, the same having been patented as above. In view of these prior publications we may well wind up our quotations with Ecclesiastes I., 9:

"There is no new thing under the sun."

One of the most important questions connected with the purification of sewage by land treatment is the area required. So far as intermittent filtration is concerned much light has been thrown upon the required area by the investigations made at Lawrence by the Massachusetts State Board of Health, the latest results of which were given in our issue of Sept. 28, 1893. With the most suitable filtering material about 100,000 gallons of sewage per acre per day seems to be a fair quantity when a high degree of purification is desired. The duty of land under broad irrigation has not been studied at Lawrence and has as yet received comparatively little scientific consideration in this country. Elsewhere in this issue there appears an article by Mr. George E. Waring, Jr., M. Inst. C. E., entitled "Area Needed for Sewage Disposal by Irrigation." In this article the author concludes that "without precluding the possibility of a considerable return in crops" the sewage from a population of from 250 to 500 persons may be disposed of upon an acre of properly underdrained land and "as cropping is put more and more into the background the population to the acre may be increased until, in the case of porous but fine sandy soils, it reaches from 1,000 to 1,500 per acre," while "if clarification, rather than purification, is the object, then these limits may be considerably raised."

The above figures are based on 60 gallons per

capita as the amount of sewage to be treated, which is equivalent to from 15,000 to 30,000 gallons an acre with crops, and from 60,000 to 90,000 gallons where no stress is laid on cropping. The latter figures are practically for disposal by intermittent filtration and correspond closely with those of the Massachusetts State Board of Health.

If it is desired to purify the maximum amount of sewage on the minimum amount of land, all recent investigations point to intermittent filtration through underdrained sand beds, with no attempts at cropping, as the best method.

As stated by Mr. Waring, if clarification, rather than purification, is all that is required, a higher rate may be employed. A higher rate should also be used in comparing the cost of land treatment and chemical precipitation, as was discussed at some length by Mr. Waring in our issue of Jan. 4, 1894, under the title, "The Partial Purification of Sewage." But in this connection it must be remembered that the length of outlet sewer or the necessity for pumping involved in getting sewage onto suitable land may make the same degree of purification more costly with land disposal than with chemical treatment.

DISTANT SIGNALS AT GRADE CROSSINGS.

There appears to be quite a tendency in this country to dispense with distant signals and to defend as good practice the establishment of signaling plants without them. In another column of this issue we give space to an argument opposing the use of the distant signal at grade crossings, by Mr. Chas. Hansel, who was formerly engineer of the Illinois Railroad Commission. We will not repeat his argument here further than to say that what he proposes is to either omit entirely the distant signal, substituting for it merely a fixed post to indicate to the engineer his approach to the crossing, or else to make the distant signal a peremptory order to stop and forbid engineers to pass it when it stands at danger.

Mr. Hansel enumerates the offices of the distant signal as follows: (1) To show the engineer that he is nearing the home signal and must be prepared to stop his train; (2) to repeat the position of the home signal and thus inform the engineer whether he must stop before reaching the home signal or may continue at full speed; (3) to protect the rear of a train standing between the home and the distant signals.

Before discussing this analysis, let us go back to first principles and consider just what is in general terms the thing accomplished by the distant signal. A good definition of this signal is as follows: The distant signal is a device for facilitating fast running by acquainting the engineer with the position of the home signal far enough in advance of it to enable the train to be stopped before passing it.

By fast running is not necessarily meant high speed. What would be fast for a heavy freight train with no air-brakes would be slow for a well-equipped passenger train. The home signal says either "stop" or "go ahead," and when it issues the former command the train must not pass it. Now if every train ran at so slow a speed that the engineer could always see clearly and certainly the position of the home signal while still far enough in advance of it to enable him to stop his train before reaching it, there would be no need of a distant signal; but experience has shown that trains cannot be limited to such low speeds. High speed is an essential in modern railroading, and if the distant signal is omitted, experience has proved that the engineer will rely on his eyesight and will more or less often mistake the indication of the signal until too near it to stop before passing it. The distant signal, then, "repeats" the position of the home signal and in effect extends the range of the engineer's eyesight, enabling him to see it plainly (or its representative) when he is still a thousand feet or more away.

Returning now to Mr. Hansel's statement of the "offices" of the distant signal, it does repeat the position of the home signal, it does serve as a "landmark" to tell the engineer where he is; but is it also, as Mr. Hansel claims, any part of its function to protect the rear of trains? On a road equipped with block signals there is no need of such protection, for each train is protected by the home signal in its rear. On a road operated under train orders every engineer is of course bound to approach fixed signals at grade crossings, drawbridges, etc., with the expectation of finding them set against him. If there be a distant signal in advance of the home signal, and that is found at danger, it is the engineer's duty to apply brakes and be prepared to stop before reaching the home signal. It is also his duty in addition to appreciate the fact that every home signal is equivalent to a station in that he is much more likely to find trains standing there than on the open road, and to keep an especial lookout for rear flagmen or tail lights, holding down his train to such speed as caution dictates. This is the case, whether he finds the distant signal standing at safety or at danger, for even if it stands at safety he cannot know that it has not been just pulled to that position in front of a standing train. Looking at the matter in this way, it is difficult to see how the distant signal can afford adequate protection to the rear of a train standing between the home and the distant signals. A long train may nearly cover the distance between the two, and the fact that the distant signal is pulled to danger even if it is kept there until the train is over the crossing, should be no excuse for relaxing the vigilance of the rear flagman.

But, contends Mr. Hansel, the distant signal is not living up to its greatest usefulness if it does not protect the rear of the train. In order to effect this object he would enact a rule that the distant signal must never be passed when it stands at danger. If the engineers obey this rule, it will undoubtedly accomplish his purpose in case a train ever stops between the two signals. But will not new complications arise? A distant signal operated under such a rule is not a distant signal, properly speaking, but another home signal (a home signal being correctly defined as a signal which must not be passed when in the danger position). But it may be laid down as an invariable rule that every home signal with no distant signal in front of it is an impediment to traffic, for it necessitates the slackening of speed by fast trains in order to approach the signal prepared to stop if it is found at danger. Moreover, does Mr. Hansel really gain anything in safety by making a home signal out of the distant signal?

— — — C — — — H — a — — — D — b — — —

In the above line let C represent the crossing, H the home signal, and D the distant signal. With a distant signal used according to ordinary rules a train finding the signals at danger will come to a full stop about at the point a, Mr. Hansel objects that in this position it is not protected from rear collisions by the signal at D. He would make that a home signal, so that a train approaching and finding it at danger would stop at the point b. In this position, however, it is, so far as fixed signals are concerned, absolutely unprotected from rear collisions; so it is not apparent that any gain in safety is made.

But Mr. Hansel finds another fault with the distant signal, and describes an accident which occurred on account of it. This is that both signals may be pulled to danger by a careless operator after a train has passed the distant signal at full speed (the engineer having found it at safety) and there may not then be time to stop before fouling the crossing. In other words, it is a disadvantage for an engineer to have so good eyesight that he can plainly read the home signal when he is 1,200 ft. away, for he will not slacken speed if he sees it at safety, and the operator may be so grossly careless as to pull it to danger and open the derail when the train is bearing down on it. It is perhaps sufficient to say that this objection, if valid, holds equally good against the use of the distant signal operated under the rules which Mr. Hansel proposes.

So much for the use of the distant signal at grade crossings. As respects the general problem of the use or non-use of the distant signal, it must be freely conceded that the ideally safe way of moving trains would be to have home signals only and have every train slacken speed at every home signal so as to be under entire control when the engineer reaches a point where he can read the home signal with absolute certainty. Such a rule means a low limit to train speeds, it means delay to traffic by every storm and fog. It was perhaps possible to enact and enforce such a rule in some degree when signals were very few and far between; but the extended use of signals which is necessary under present conditions makes such rules and methods impracticable. Never establish a law or rule which cannot be enforced is a precept which it were well to heed. The public demands high speeds, and the traffic and motive power departments make every effort to secure it. It is the object of modern signaling devices to make high speeds compatible with safety, and to discard the methods and appliances which effect this is to take a long step backward.

It appears to be true that there is not a proper appreciation of the office and purpose of the distant signal among trainmen and probably among railway managers as well.* This is an evil which will disappear with more extended use of fixed signals and general education concerning their importance and value; and while accidents may occur through misuse of distant signals, experience has shown that they also occur and occur frequently by reason of their absence.

It may be of interest to note in this connection an example of the importance of distant signals to fast trains. On March 6, 1883, the Empire State Express on the New York Central & Hudson River R. R. ran into a construction train at Tivoli. The block signals were then in operation, and both home and distant signals at the end of the block occupied by the work train were at danger. The distant signal was 1,954 ft. from the home signal, and before passing the distant signal the engineer had shut off steam and applied the brakes. The train was running, however, at a speed of 75 miles per hour and notwithstanding the retarding action of the brakes the train ran 487 ft. past the home signal and crashed into the work train at a speed of 20 miles an hour. The New York Board of Railroad Commissioners after investigating this accident recommended "that the distance between the distant signal and the home signal in each block should in all cases be sufficient to permit a train running at the highest speed to be brought to a full stop at the home signal under the most unfavorable circumstances."

Had the engineer not been warned by the distant signal, he could not have seen the home signal until within only 851 ft. of it, and would have crashed into the work train at much higher speed.

LETTERS TO THE EDITOR.

LOUISVILLE & JEFFERSONVILLE BRIDGE DISASTER.

Sir: If you will look again at the cross-section of falseworks shown on the inset sheet of your issue of Dec. 28, 1893, you may find one or two items that seem to have escaped comment, and may possibly have escaped notice. The bottom panel of the framed bent just above the pile cap has only half as much sway brace strength as any one of the three panels above it, and the sway bracing on the upper part of the piles, while being practically the same as in the upper panels of the framed bent, has about three times as much horizontal shear to resist, owing to the leverage of the unbraced portion of the piles above the river bottom. This shear on the sway braces is even more than three times as great since there is no batter in any of the piles and consequently no relief from them. It would have made a much more rigid foundation, laterally, without appreciably increasing the cost, if the outer pair of piles at each end of the bent had been spaced about 8 or 10 ft. apart where they entered the mud bottom, and either driven on a batter or their tops pulled in to a batter after driving. It is exceedingly probable that the bolts connecting the sway braces to the piles were either sheared off by the force of the wind or bent so far out of their original position as to be worthless, and that the piles then went over in the direction of the wind as though they were practically without lateral sway bracing. It would seem as if the collapse of the falsework ought to be ascribed altogether to its lack of lateral rigidity and not to any longitudinal weakness nor to any deficient supporting power of the pile foundation.

Yours truly,

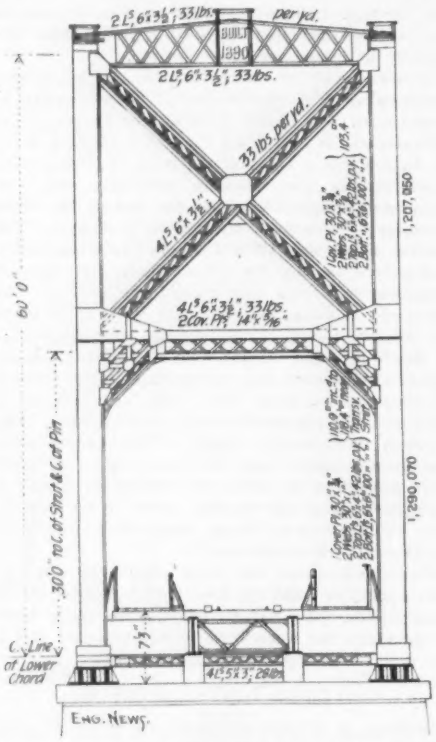
Jno. A. Fulton, M. Am. Soc. C. E.

Chicago, Ill., Jan. 9, 1894.

Sir: The fall of a practically completed span of the Louisville & Jeffersonville Bridge, described in your

* See editorial discussion in connection with rear collision on Fitchburg R. R. (Eng. News, Oct. 20, 1892).

issue of Dec. 28, draws attention to current theories and practice with respect to the portal bracing in long-span bridges. The end post in the Louisville & Jeffersonville Bridge was nearly 86 ft. in length, and it will probably be conceded by every one that the bridge was as good and safe a structure with a splice joint at the center of this post as it would have been had it been attempted to make the end post a single member 86 ft. in length, a task which would appear to have been a very difficult one to attempt. From the figures given on the strain sheet, shown on your first drawing, it appears that each half of the end post was figured as a separate column, the joint at the center being considered supported in a vertical plane by the inclined web member and in the plane of the two end posts by the portal bracing. The support afforded by the web member will doubtless be conceded to be sufficient to justify this method of computation so far as the tendencies to bend the end post in a vertical plane are concerned; but can we say as much for the portal bracing? The strain in this, due to the assumed wind pressure, can be computed easily, but in addition to these strains are the un-



Elevation Showing Portal Bracing of 546½-ft. Span, Louisville & Jefferson Bridge.

known forces exerted by the end posts on the portal bracing in tending to deflect to the right or left when under compression.

It is to be further remembered that all the lateral force exerted by the portal bracing must be carried down to the abutment by the lower half of the end post, and tends to bend it at the point where the bracing is attached. The section of the post is increased from 110.9 sq. ins. to 118.4 sq. ins. at this point to take up the bending strains; but while I have not computed it, this appears to me insufficient to safely take up such a bending strain as the portal strut may bring to bear.

To put my criticism in the fewest words, should not the lower half of the end post in long-span trusses be either trussed or made much wider than is now common practice, and should not larger and heavier portal bracing, extending farther down the post, be used in such spans?

Very truly yours, Alpha.

New York, Jan. 16, 1894.

(We have referred these letters to the Phoenix Bridge Co. who answer that the increase in the section of the end post noted in "Alpha's" letter was calculated to withstand the bending strains and will be found amply sufficient for that purpose; also that the portal bracing was extended as far down as was possible and yet allow ample room for the smokestack of the locomotive. In respect to Mr. Fulton's letter it is stated that the sway braces noted as included in the three upper stories and omitted from the first story above the piles are simply secondary braces to hold the joints and not a part of the main bracing to resist the wind pressure.—Ed.)

Sir: Two editorials were published in the "Engineering Record" of Dec. 23 and Jan. 6 on the disaster to the Louisville & Jeffersonville Bridge, and I think in the interests of fairness that public attention should be called to certain statements therein contained. In the first editorial it is stated that only the horizontal 8 × 12 ins. longitudinal ties of the falsework were undoubtedly in place, but that no diagonal longitudinal bracing had been placed because "our correspondent, Mr. Cornwell, indicated that it was omitted." The plan of falseworks, sent by the Phoenix Bridge Co. and printed on the same sheet as Mr. Cornwell's sketch, clearly indicates the diagonal bracing, while the photographs, when carefully examined, are conclusive evidence of its being actually in place. Yet the editor deliberately preferred a hastily made sketch to the drawins of a responsible bridge company and to the unfailing evidence of a photograph. He might have assumed that the bridge company had drawn in the diagonal lines after the accident, or what is still more improbable, that they had been shown in the original plans, but left out in the field, but he cannot accuse the photographic plate of such conspiracy. He quotes from Mr. Deans that "additional X bracing was also put in at a number of points in no special or systematic manner," as an undoubted confirmation of his views, whereas Mr. Deans refers principallly to horizontal X bracing, which was put in at the top of the piles as an additional precaution. The Phoenix Bridge Co. claims that the original plan of falseworks was strictly carried out, which statement is confirmed by the photographs and by the testimony of numerous reliable winesses not connected with the Bridge company. How the omission of an explicit statement from Mr. Deans about longitudinal X bracing can be construed as a confession that such bracing was not in, it is difficult to understand.

Starting from his own unwarranted assumption, the editor unconsciously contradicts his own reasoning about "twore strength" by stating that if the X bracing had been in place the falsewoks could not have collapsed as they did. But as shown above, the bracing WAS there and the falseworks did go in exactly the manner they could not have gone according to the editor. As soon as one bent had been crushed by the weight of the traveler, the iron already in position, overhanging as a cantilever, would bring undue weight and an overturning tendency on the succeeding bent, tipping it over, and so on, the forces acting with increased momentum as the structure falled piece by piece. Where such a contradiction existed, as is above shown, it would have been no more than professional courtesy to send to both Mr. Cornwell and Mr. Deans, asking them to confirm their views.

In the second editorial the editor evidently feels the untenableness of his position and tries to extricate himself from it, with the result of only involving himself more deeply in contradictions. He says that Mr. Deans' "corrections seriously need correcting," and as the only proof of this statement he reiterates that because "Mr. Deans in neither letter makes any specific statement to the effect that the sketch (Mr. Cornwell's) is not essentially correct" and "the erectors were making haste, though too late, to supply the fatal omission," therefore no longitudinal X bracing was in place. He certainly must have had time enough between the first and second editorials to verify his data, but he has not taken the trouble to do so. The statement that the erectors were making haste, etc., he puts in quotation marks, making it appear from the context that it occurred in Mr. Deans' letter, whereas it is taken verbatim from his own previous editorial. Therefore this cannot be taken seriously, but certainly must be a "pseudo-ratiocination."

As for the second part of the disaster, the blowing down of the 550-ft. span, the editorials make the mistake, in common with so many other people, of jumping to a conclusion without sufficient information. The statement that no cyclone disturbance could possibly have happened for the reasons given is absurd, and is contradicted both by Mr. Deans' and Mr. Collingwood's letters, besides a mass of concurrent testimony for which there is no space now. The writer believes that many engineers have been overzealous in their efforts to point a useful moral from the disaster, they being loth to believe that such an event should have happened, without calling strong attention to some points of design which they think have been neglected in general practice. However that may be, opinions may differ, but facts should be stated correctly, especially by such a technical journal as the "Engineering Record." It is therefore no more than fair that on such inaccuracies being pointed out, the mistakes inadvertently made should be rectified in as prominent a manner as they were originally stated.

Yours truly, Henry Szlapka, Bridge Engineer.

Trenton, N. J., Jan. 13, 1894.

(We are informed by Mr. Szlapka that he has already submitted the above communication to our contemporary, the "Engineering Record," which refused to publish it. We therefore give space to it in our columns, as it is certainly for the interest of the profession that no published errors or inaccuracies concerning this important engineering disaster should be permitted to stand unchallenged. —Ed.)

ALUMINUM IN CAR CONSTRUCTION.

Sir: I have read with considerable interest the article on "Metal Underframes for Railway Cars" in your issue of Feb. 1. In this connection I wish to call your attention to the advantage of the use of aluminum for these car frames, instead of steel. The metal can be furnished in castings which will bend double without fracture, and which will have a tensile strength of 40,000 lbs. per sq. in. when alloyed with a few per cent. of hardening ingredients, and will have a specific gravity of less than 3. In drawn tubes, the metal can be furnished with a tensile strength of 50,000 lbs. per sq. in. elastic limit at least one-half the ultimate,—metal which will bend nearly double before fracture. Either in rolled or drawn metal the specific gravity will be very close to that of pure aluminum, there being less than 3% of hardening ingredients in it. I am confident that, due to its tensile and compressive strength, its lack of corrosion, and its lightness, aluminum is the metal par excellence for car frames, and that it will be only a little time until it will become largely used for this purpose. I take pleasure in sending you with this letter a test bar of rolled plate having a tensile strength of over 45,000 lbs. per sq. in. and a specific gravity of 2.8. This metal is capable of being either drawn into tubes or forged satisfactorily.

Very respectfully, The Pittsburg Reduction Co.
Alfred E. Hunt, President.

(Granting all Mr. Hunt claims, the price of aluminum (now about 75 cts. per lb.) will have to take a very material drop before car builders will see their way clear to any extensive use of it. Steel channels are now quoted at about 1.75 cts. per lb., or considerably less at the mills, and even this low price has not been sufficient to bring about anything more than an experimental use of steel in place of timber for car framing.—Ed.)

WHAT IS THE CAUSE OF BENT RAILS?

Sir: On several occasions I have had to examine some track on account of bent rails. The damage to the rails being of peculiar nature, I would be glad to have any information that will enable me to determine the direct cause of the bending. The heads of the rails were bent down from 1-16 in. to ⅝ in. and inward (i. e. toward the center of the track), from ¼ in. to ⅝ in. The base and web of the rails were bent down as well as the head. The inward bend faded out about halfways down the web. The bends occurred sometimes on top of a tie, which was thereby crushed, and sometimes between the ties. The ties were of hemlock and tamarack, spaced 2,640 to the mile.

In one case the bends were about 16 ft. 3 ins. c. to c. and were on one side of the track only, the outside rail of a 1° curve, on a long grade of 0.43%, laid with 72-lb. steel. There was no mark visible on the head of the rail. In another case the bends occurred partly on a tangent and partly on a 2° curve, at the bottom of light adverse grades, laid with 60-lb. steel, the bends occurring on both rails in some places.

Where both rails were bent, the bend on one rail was always about 3 ft. 8 ins. behind the bend on the opposite rail. In this case there was a mark of a worn tire on the head of the rail, for from 28 to 34 ins., starting at nothing on the outside of the head of the rail and in the center of the mark ¾ in. in from the outside of the head. It then ran out to nothing again at from 28 to 34 ins. from the commencement of the mark, the center of this mark corresponding to the center of the bend in the rail.

The track was in fair surface and good line where these bends occurred. The elevation for the curves was 1 in. per degree and the run-out on tangent was 75 ft. per degree. Track was ballasted with gravel.

The engines that run over this track are of the mogul type, with the diameters of drivers and total weight on driving axles as follows:

51-in. wheel,	88,000 lbs. on driving axles.					
57-in. "	87,000 " " " "					
62-in. "	87,900 " " " "					
69-in. "	93,000 " " " "					
75-in. "	84,000 " " " "					
Diam. of drivs., ins.		51	57	62	69	75
Total wt. on driving axles, lbs.		88,000	87,000	87,900	93,000	84,000

Truly yours, R. E. K.

Smith's Falls, Ont., Feb. 3, 1894.

(We should be inclined to ascribe the damage to too heavy counterbalances on some locomotive or locomotives running over the road. Perhaps some such engine with the side rods taken down has been hauled over the road at high speed. When a locomotive is in this condition the "hammer blow" of

the counterbalance weights becomes very excessive, if anything like high speed is attempted. Perhaps some of our readers may furnish further information for our correspondent's benefit.—Ed.)

ENERGY AND MOMENTUM.

Sir: Will you or some of your readers kindly answer a question which arises from the following problem: Two perfectly non-elastic bodies whose weights are 10 lbs. and 8 lbs. and velocities 12 ft. and 15 ft. per second, respectively, moving in opposite directions, impinge upon each other: required their common velocity after impact. The momentum of the first body equals $\frac{10 \times 12}{g}$. The momentum of the second body equals $\frac{8 \times 15}{g}$. The momenta of the bodies being equal, they will be brought to rest. ("If two inelastic bodies of equal momenta impinge directly upon one another from opposite directions they will be brought to rest."—Wood "Prim. of Elem. Mech.," p. 86.) Since the bodies are brought to rest, all the kinetic energy in the bodies before impact is lost.

Now the kinetic energy in the first body before impact equals 22.4 ft.-lbs. = weight × by the height through which the body must fall to produce a velocity of 12 ft. per sec. $\left(\frac{Wv2}{2g}\right)$. The kinetic energy in the second body before impact is 28 ft.-lbs. What becomes of the excess of kinetic energy in the second body? X. Y. Z.

(Our correspondent's mathematics are entirely correct, and if he will now cut loose from his theory for a little and apply his practical knowledge, he will have no difficulty in solving the question that he propounds. He supposes two perfectly inelastic bodies to collide, and, while in practice no such thing as perfectly inelastic or perfectly elastic bodies exist, it is familiar knowledge that the result of a collision between two inelastic bodies is a smash. If the two bodies he instances above are two balls of putty which strike each other squarely, both would be crushed and the surplus kinetic energy of the lighter ball moving at the higher velocity is expended in crushing and distorting the two balls. This work done in crushing will be a constant and the amount of injury suffered by the colliding bodies will depend on their actual strength and elasticity. Two colliding glass balls would be shattered to fragments, while two balls of copper would be merely slightly flattened. It is also of interest to point out that while the opposing momenta in the case cited neutralize each other, the energy of the two bodies is not destroyed, but merely transformed. All the energy save that expended in crushing and tearing the colliding bodies reappears as heat. If our correspondent prefers an algebraic discussion of the subject, we would refer him to Weisbach's "Mechanics," p. 667.—Ed.)

LONG STEEL TAPES.

Sir: Inasmuch as you have given in your issue of Feb. 1 a quite lengthy account of the "Recent Experience on the U. S. Coast and Geodetic Survey in the Use of Long Steel Tapes for Measuring Base Lines," a summary of the early experience of others in the same field seems in order.

As early as 1881 use was made of a steel tape 299 ft. long for measuring base lines. The method, as briefly described in the report of the Mississippi River Commission for that year (App. B, p. 28), shows the use of supporting stakes, spring balance tension, and marks on the heads of copper tacks. The discrepancy in two measurements of the Cairo base, which was about 1,600 m. in length, was 9.45 mm.

Missouri River Commission report, 1886, p. 32, et seq., gives a full description of the method of measuring bases with long steel tapes, and gives five full page photographs of the apparatus in use. On page 41 of the same report Assistant Engineer O. B. Wheeler gives a detailed account of his ingenious devices and excellent results. His differences in measuring two bases were:

Benton Base, July 10, 1885.		Trover's Point Base, Sept. 26, 1885.	
Meters.	Millimeters.	Meters.	Millimeters.
3008.5048	— 29.259	2999.8883	+ 4.875
	+ 13.106		+ 1.571
	— 3.657		— 5.438

When, in order to ascertain the length of his tape, he measured the Olney base of the Lake Survey (Professional Papers No. 24, Corps of Engineers, U. S. A.) Oct. 28, 1885, his two measurements differed 1.248 mm. in the length, 3298.5414 m.

The matter has become so far "res adjudicata" that Prof. J. B. Johnson, in his "Theory and Practice of Surveying," published about that period, allows but two pages and a picture for a brief description of the U. S. Coast and Geodetic Survey four-meter contact-slide base apparatus, and devotes 26 pages to the method of measuring base lines with steel tapes, as developed principally on the Missouri River.

I said he allowed two pages to the old-time method, but one of those is abridged by a foot-note mentioning the ice-packed bar proposed by Mr. E. S. Wheeler, U. S. Asst. Engineer, as a means of obtaining a standard of constant length. The foregoing is public record, and the reports can be had for the asking. To bring you "up to date" in this matter, and to show by what right I challenge any claim to pioneership at this late period, marked copies of the Annual Report of Capt. J. H. Willard, U. S. A., for the years 1889, 1890 and 1893, will be sent to you by this mail. Your attention is invited to pages 1591 and 1592 of the 1889 report; pp. 1830 and 1831 of the 1890 report, and to p. 1926 et seq. of the 1893 report. If you will read in the last, near the bottom of p. 1927, it will be plain that spring balances, zinc strips and awls are no longer scientific instruments to use in base measuring.

The design for the apparatus was given to W. & L. E. Gurley, of Troy, New York, Feb. 23, 1889; the order for the tapes to Gowdey & Son, on the same day. The U. S. Coast and Geodetic Survey engraved the graduations on the brass and steel tapes during November and December of the same year, and Colonel Flagler, Ordnance Dept., made tests of the strength of specimens the following June.

The results of the Red River survey measurement of Delta base (p. 1931, report of 1893), if prolonged to the length of St. Albans base, would be:

	mm.
Constant	+ 17.39
	+ 15.05
	+ 18.56

and of the Lum Point Base (p. 1932):

	mm.
Constant	+ 18.56
	+ 52.10
	— 7.18

The measurements at Lum Point were indirect, as the base and tape are incommensurable, and were intended only to test the length of the tape derived from Delta base. The tape is 100.61300 m. by one set and 100.61310 m. by the other.

As a firm believer in the advisability of—nay, more, in the necessity for, complete mathematical attainment to the best knowledge of engineering, permit me to protest against juggling with results by imposing suppositions. "Probable error," when based on a large number of observations, means simply that the chances are equal that the error of the result is greater or less than the quantity preceded by — sign. When the observations are limited, a careful inspection gives a clearer conception of the accuracy of the work; or the discrepancy between each observation and the mean of all the observations, expressed as a ratio to whole quantity observed, gives a better measure of the value of the method. As Mr. Woodward says, "There is a striking fact brought out"; that is, the "lag" discovered when the Coast Survey began measuring base lines with long steel tapes. Perhaps they will next trade off their precise level apparatus when they get their transcontinental line beyond St. Louis. Yours respectfully, H. M. Marshall.

Vicksburg, Feb. 6, 1894.

(We find the records published in the reports of the Chief of Engineers as referred to by our correspondent, clearly proving priority of application. We expect to describe the base measuring apparatus used by Mr. Marshall in a following issue.—Ed.)

FROG AND SWITCH FORMULAS.

Sir: Thanking you for space which I have already occupied in your journal, will you kindly allow me one or two lines more? Replying to your comments in Engineering News of 11th inst. I would say that the number of the frog is not always given, as you seem to assume, and also, to be general "9.5 n = L," should be 2 g n = L. Further, the "fact" which you present in capitals and suppose unknown to me, you will find recorded on page 138 of the "Fieldbook."

With the interests of the engineer in view and the application of correct principles in his practice, you will, I trust, appreciate an effort to supply accurate formulas in convenient form. The well known approximate formulas to which you refer can readily be supplied by the engineer himself whenever desired, but they are obviously more in the line of the tracklayer. When the engineer is needed, as a rule, something better than approximate methods is required.

The demand for greater accuracy is growing daily on account of complicated terminal and special connections. A good example appears in the connections covered by the interlockings referred to in Mr. O'Donnell's article on the same page of the News, to which this communication refers. My opinion is that we should have as good formulas for track connections to meet these cases as for location. For the latter we find, very properly, several pages devoted to problems on curves, though in every case the transitman might, if required, stake out the curve on the ground without the formulas.

Very respectfully, L. C. Weldin.

Pittsburg, Pa., Jan. 24, 1894.

(We shall be sorry indeed when the day comes that it is regarded as "more in the line of the tracklayer" than the engineer to use "approximate methods," which hardly differ by a hair's breadth, if at all, from "something better," i. e., more precise, and which differ that little harmlessly. The only effect of such all too-prevalent notions is to injure the excellence of their work in essentials and make it unnecessarily costly, and thus to injure the standing of engineers as a class among the practical men on whom their success depends.—Ed.)

NEW LOCOMOTIVES FOR THE NEW YORK ELEVATED RAILWAYS.

On all the elevated railways now in operation in this country the locomotives used are of the Forney pattern, having four driving wheels under the boiler and a four-wheel trailing truck under the rear bunker and tank. These engines on the New York elevated railways have been developed from six tons weight in 1871 to 17 tons in 1877, and 24 tons in 1893, and we illustrate this week one of the latest of the engines built for these lines.

The first elevated railway in New York city was the line on Greenwich St., extending through that street from the Battery to Cortlandt St., which was built by the West Side & Yonkers Elevated R. R. Co. in 1868, and operated by an endless chain. In 1870 this company extended the line to Thirtieth St., and also operated this extension by endless chain. This method proving a failure, however, small four-wheel locomotives inclosed in cabs, like dummy engines, and having small saddle tanks on the boilers were introduced in 1871. The cylinders drove a crank axle between the main axles, with connecting rods to the driving wheels. The ordinary train consisted of two cars of 11,000 lbs. each, seating 48 passengers, but three cars were sometimes hauled. The length of trip was four miles, with seven stops, and was made in 20 minutes, the engines making ten round trips per day. The line had a maximum grade of 2% and minimum curve of 56 ft. radius. In the autumn of 1871 the New York Elevated R. R. Co. was organized and additions to equipment and extensions to line were gradually carried on. In 1877, when a reorganization was effected and additional extensions made, some larger four-wheel engines were built, as well as some of the Forney type. The Metropolitan Elevated Ry., which was organized in 1876, and opened its Sixth Ave. line in 1878, was first operated by double-end dummy engines, having four driving wheels and leading and trailing pony trucks. These were built in 1877, and later ones of the same type had boilers of greater capacity, and the cabs considerably shortened. For the particulars of the growth of these roads we are indebted to Col. F. K. Hain, Second Vice-President of the Manhattan Ry. Co. Both the New York Elevated R. R. and the Metropolitan Elevated Ry. are now owned by the Manhattan Ry. Co., and the equipment (exclusive of the 13 engines and 28 cars of the Suburban Rapid Transit Ry.) is 311 engines and 1,090 passenger cars. The engines are all of the Forney type, built by different locomotive works. The principal repair shops are at Ninety-eighth St. and Third Ave., and the entire mechanical department is under the charge of Mr. T. W. Peeples, Master Mechanic, to whom we are indebted for the general dimensions of the different types of engines used at various times, as given in the accompanying table. Three sizes of Forney engines were built in 1878, having cylinders 10×14 ins. and 10×16 ins. and weighing 29,890 lbs., 32,760 lbs. and 35,140 lbs., with 19,170 lbs., 21,410 lbs. and 23,790 lbs. on the driving wheels.

The Belpaire firebox is largely used, the first engine equipped with it being built in 1887, and in the new engines illustrated herewith there is a combination of Belpaire firebox and extended wagon-top boiler, which is the first combination of the kind. The dome is on the extension. The com-

bination of Belpaire firebox with an ordinary wagon-top boiler was first employed on the Brooks eight-wheel express engines built for the Exposition Flyer on the Lake Shore & Michigan Southern Ry. (Eng. News, June 15, 1893), the dome being on the slope sheet. The extension smokebox is not used; and although two-cylinder and four-cylinder compounds have been introduced on the Brooklyn and Chicago elevated railways, simple engines are used exclusively on the New York roads. The latest addition to the equipment of the Manhattan Ry. consists of 20 engines built by the Pittsburg Locomotive & Car Works, of Pittsburg, Pa. The engines are designed to haul a load of five cars weighing 29,000 lbs. each, or 145,000 lbs. in all, on a grade of 2.5% and at a maximum speed of 25 miles per hour. Frequently there are 100 passengers in each car. We are indebted to the builders for the accompanying list of dimensions, which is given in our standard tabular form:

DEVELOPMENT OF LOCOMOTIVES OF THE NEW YORK ELEVATED RAILWAYS: 1873 TO 1894.

	1873.	1878. December.	1878. September.	1878. September.	1878. December.	1879 April.	1879. August.	1880. June	1881. April.	1884. January.	1886. May.	1892. December.	1894. January.
	Four-wheel.	Four-wheel.	Four-wheel.	Forney.	Forney.	Forney.	Double-end.	Double end.	Forney.	Forney.	Forney.	Forney.	Forney.
Driving wheels..	2 ft. 9 ins.	7 ft. 10 ins.	3 ft. 2 ins.	3 ft. 2 ins.	3 ft. 2 ins.	3 ft. 6 ins.	3 ft. 8 in s.	3 ft 3 ins.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.
Wheel base, driv.	5 " 0 "	6 " 0 "	6 " 0 "	5 " 3 "	5 " 0 "	5 " 9 "	5 " 0 "	5 " 0 "	5 " 0 "	5 " 0 "	5 " 0 "	5 " 0 "	5 " 0 "
" " total.	5 " 6 "	6 " 0 "	6 " 0 "	15 " 0 "	15 " 0 "	16 " 1 "	16 " 4 "	16 " 7 "	16 " 1 "	16 " 1 "	16 " 1 "	16 " 1 "	16 " 1 "
Wt. on drivers ..	12,000 lbs.	15,700 lbs.	26,000 lbs.	19,250 lbs.	21,250 lbs.	24,250 lbs.	35,310 lbs.	35,050 lbs.	28,000 lbs.	30,100 lbs.	32,500 lbs.	31,200 lbs.	33,000 lbs.
" total.....	12,000 "	15,700 "	26,000 "	33,000 "	36,000 "	37,900 "	45,680 "	43,450 "	40,300 "	43,200 "	45,400 "	49,630 "	47,000 "
Cylinders.....	6 × 12 ins.	9 × 10 ins.	10 × 14 ins.	10 × 14 ins.	10 × 14 ins.	10 × 16 ins.	10 × 20 ins	11 × 16 ins.	11 × 16 ins.	11 × 16 ins.	12 × 16 ins.	12 × 16 ins.	12 × 16 ins.
Boiler, style.	Straight	Straight	Straight	Straight	Straight	Straight	Wag. top	Wag. top	Straight	Belpaire	Belpaire	Ext. wag. top.	Belp. ext. wag. top
" diam.....	.....	.....	2 ft. 10 ins.	2 ft. 10 ins.	3 ft. 4 ins.	3 ft. 4 ins.	3 ft. 4 ins.	3 ft. 4 ins.	3 ft. 4 ins.	3 ft. 6 ins.	3 ft. 6 ins.	4 ft. 1 in.	4 ft. 1 in.
												3 " 6 ins.	3 " 6 "
Firebox, length..	.....	. .....	3 " 6 "	3 " 6 "	3 " 6 "	3 " 6 "	4 " 6 "	3 " 9 "	3 " 6 "	4 " 7 "	4 " 7 "	3 " 6 "	3 " 11 "
" width	.....	.....	2 " 11 "	2 " 11 "	2 " 11 "	2 " 11 "	3 " 0 "	2 " 11 "	2 " 11 "	3 " 7 "	3 " 7 "	2 " 11 "	3 " 7 "
Grate area.....	.....	.....	10 sq. ft.	10 sq. ft.	10 sq. ft.	10 sq. ft.	12 sq. ft.	11 sq. ft.	10 sq. ft.	16.5 sq. ft.	16.5 sq. ft.	10 sq. ft.	14 sq. ft.
Tubes, number..	.....	.....	100	112	112	112	172	172	112	124	154	160	185
" diam.....	1¾ ins.	1¾ ins.	1¾ ins.	1¾ ins.	1¾ ins.	1¾ ins.	1¾ ins.	1¾ ins.	1¾ ins.	1½ ins.	1¾ ins.	1¾ ins.	1½ ins.
" length...	.....	.....	5 ft. 6 ins.	6 ft. 10 ins.	6 ft. 7 ins.	6 ft. 10 ins.	7 ft. 0 ins.	6 ft. 6 ins.	6 ft. 10 ins.	5 ft. 8 ins.	6 ft. 3 ins.	7 ft. 2 ins.	6 ft. 11 ins.
Heating surface.	.....	.....	230 sq. ft.	356 sq. ft.	343 sq. ft	356 sq. ft.	480 sq. ft.	453 sq. ft.	356 sq. ft.	304 sq. ft.	434 sq. ft.	500 sq. ft.	552 sq. ft.
Capac. of tank...	.....	169 galls.	309 galls	475 galls	475 galls.	475 galls.	600 galls.	636 galls.	512 galls.	512 galls.	512 galls	512 galls	512 galls.
" of bunkers	.....	.....	1,500 lbs.	1,500 lbs.	1,500 lbs.	1,500 lbs.	.....	.....	2,500 lbs.	2,500 l s.	2,500 lbs.	2.500 lbs.	2.500 lbs

Running Gear.	
Driving wheels, diam.	3 ft. 6 ins.
Truck " "	2 " 2 "
Truck, swing or rigid center	Swinging
Journals, driving axles	5½ × 6¾ ins.
" truck axles	3¼ × 6 "
Wheel Base.	
Driving	5 ft. 0 ins.
Truck	4 " 8 "
total	16 " 1 "
Weight in Working Order.	
On drivers	33,000 lbs.
On truck wheels	14,000 "
Engine, total	47,000 "
Of full coal capacity	1,600 "
Of full water capacity of tank	4,267 "
Allowed for water in boiler	4,000 "
Cylinders	12 × 16 ins.
Distance center to center	6 ft. 4 ins.
" center to valve face	10½ "
Piston rod, diam.	2⅛ "
Form of crosshead and guides	Single bar
Connecting rod, length between centers	5 ft. 0 ins.
Valve Gear.—Type	Link
Ports, steam	8¾ × 1⅝ ins.
" exhaust	8¾ × 1¾ "
Slide valves; lap, ⅝ ins.; max. travel, 4 ins; lead, 1/16 "	
Boiler.—Type	Extended wagon top
Diam. of barrel inside	3 ft. 5⅛ ins.
Thickness of barrel plates	1/2 "
Thickness of smokebox tube plate	5/16 "
Height from rail to center line	5 ft. 6¼ "
Length of smokebox	2 " 9 "
Working steam pressure	140 lbs.
Firebox.—Type	Belpaire
Length inside	3 ft. 11 ins.
Width inside	3 " 6¼ "
Depth at front and back	3 " 3½ "
Thickness of side and back plates	5/16 "
" crown sheet	1/2 "
" tube sheet	5/16 "
Grate area	14 sq. ft.
Staybolts, diam. ⅝ ins.; pitch	4½ ins.
Water space, width	2½ "
Tubes (steel); number, 183; pitch	2⅛ "
Diam. inside, 1.31 ins; outside	1¾ "
Length between tube plates	6 ft. 11 ins.
Heating Surface.	
Tubes, exterior	492 sq. ft
Firebox	54 " "
Total with exterior tube area	546 " "
Miscellaneous.	
Exhaust nozzle, diam.	4 ins.
Smokestack, smallest diam	1 ft. 2 "
Smokestack, height from rail to top	12 " 1⅝ "
Capacity of tank	512 galls.
Capacity of coal space	1,600 lbs.
Brake fittings	Eames vacuum

WILLIAM PRICE CRAIGHILL, PRESIDENT AMERICAN SOCIETY OF CIVIL ENGINEERS.

(With inset.)

Col. William Price Craighill, of the Engineer Corps of the United States Army, who was elected president of the American Society of Civil Engineers at the last annual meeting, was born on July 1, 1833, at Charlestown, Jefferson Co., Va. (now in West Virginia). His earlier education was received at the classical and mathematical academy of his native town, and on July 1, 1849, he was appointed a cadet at West Point, graduating on July 1, 1853, as second in a class of 52 members. In this class were Generals Sheridan, Schofield, McPherson, Sooy Smith, Still, Vincent, Terrill and Tyler, on the Union side during the Civil War, and Generals Hood, Chambliss and Walker, of the Confederate Army.

Graduating as a Brevet Second Lieutenant of the Corps of Engineers, he has since passed through all intervening grades to that of senior colonel of his corps, with a strong probability of succession in 1895, to the position now held by the present distinguished Chief of Engineers, Brig.-Gen. T. L. Casey.

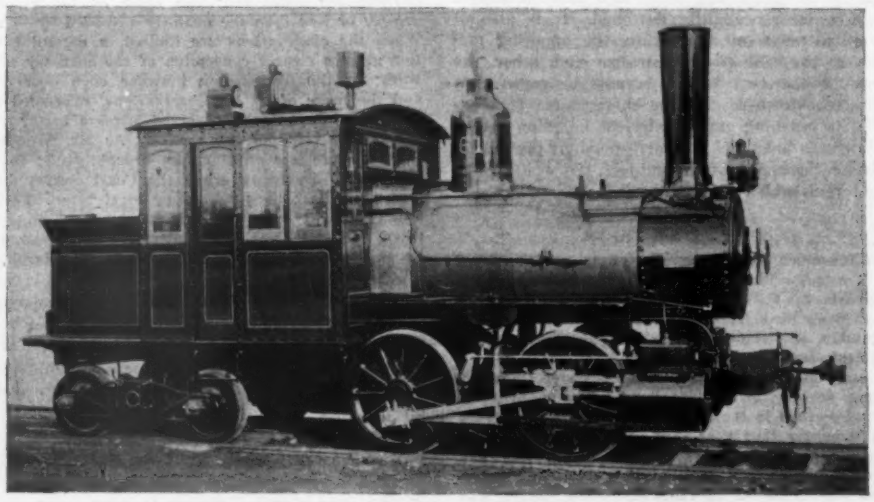
During the Civil War he received the brevets of lieutenant-colonel and colonel for services performed. At various times during that struggle he had charge of the fortifications of Washington, Baltimore, Hampton Roads, Charleston, Savannah, the Dry Tortugas and Delaware River. He was also on the special board to arrange defences for San Francisco when the French were in Mexico and threatened to invade California, and immediately after the war he served on a board to revise all the fortifications of the United States.

For four years he was assistant professor of military and civil engineering at the U. S. Military Academy, at West Point, when Professor Mahan, whose name is familiar to every civil engineer, was at the head of that department. From 1856 to 1859 Colonel Craighill was assistant in the Engineer Bureau, in the War Department, while General Totten was at the head of the Engineer Corps; and again, from 1866 to 1870, he was on duty in the Engineer Bureau.

In connection with river and harbor duty, Colonel Craighill has had active charge of many important public improvements all over the United States and has taken an active part in the projects for many others. Among harbors may be mentioned those of New York, Philadelphia, Baltimore, Norfolk, Charleston and Savannah. He has had much to do with river improvement, and among the chief may be mentioned the Columbia, Mississippi, Ohio, Tennessee, Kentucky, Delaware, Patapsco, James, Appomattox, Kanawha, Cape Fear, Cumberland and St. Johns. He has been professionally employed upon harbors of refuge at the mouth of the Delaware, and on the coasts of Massachusetts and Southern California and has directed the surveys for ship canals between the Chesapeake and Delaware bays, the connection of the Atlantic coast and the Mississippi Valley by way of the James, Kanawha and Ohio rivers and he was one of the board appointed to consider the proposed Sturgeon Bay ship canal, near Milwaukee.

Colonel Craighill has been twice sent to Europe on engineering missions for the general government and has five times visited the Pacific coast on similar service. He was president of the board appointed to select and recommend to Congress sites for manufacturing heavy guns on the Pacific and Gulf coasts; was a member of the Lighthouse Board in Washington for several years, and has had the position of Superintendent of the Military Academy, at West Point, several times offered to him.

Colonel Craighill has been a member of the American Society of Civil Engineers since Oct. 7, 1885, and for two years was a member of the Board of Direction of that body. He is also a member of the American Association for the Advancement of Science, the Historical Society of Maryland and the American Economic Association. In 1861 he compiled "The Army Officers' Pocket Companion"; in 1863 he translated and published General Dupont's "Cours de Tactique," and, in connection with Captain Mendell, he also translated General Jomini's "Precis de l'Art de la Guerre."



LOCOMOTIVE FOR NEW YORK ELEVATED RAILWAYS. Builders, Pittsburg Locomotive Works

While the corps of engineers of the United States Army is represented in the list of honorary members of the American Society of Civil Engineers by three distinguished men who have all held the office of Chief of Engineers, U. S. A.—Generals Duane, Newton and Wright—Colonel Craighill is the first member of that corps who has been elected a president of the society. Considering the eminent standing of the engineer corps, professionally and personally, and the fact that it has had for years a number of representatives in the list of members of the American Society, this is a well merited

recognition and one which might well have come earlier. Colonel Craighill personally has every quality necessary for the honorable office to which he has been chosen. He has had long and very varied professional experience; he is most affable in manner, is a good disciplinarian, and talks like a soldier, saying what he has to say tersely and clearly. The society cannot fail to be benefited by his control in the ensuing year.

THE USE AND ABUSE OF THE DISTANT SIGNAL AT GRADE CROSSINGS.

By Charles Hansel, C. E.

The rules of the Railroad and Warehouse Commission of Illinois describe the distant signal as follows:

> The distant signal should be located not less than 1,200 ft. in advance of the home signal with which it operates, on the same side of track, with the arm pointing in the same direction. . . . It must be so arranged and connected with the home signal that it will be held in a horizontal position . . . when the home signal indicates danger.

There seems to be no specific requirement in the order of the Commission for the putting in of a distant signal at all plants. The rule simply specifies how a distant signal, when put in, should stand in relation to the home signal.

There is some difference of opinion as to the office of a distant signal. Is it to be considered simply as a marker to show the position of train as regards the crossing? Is it intended to be a tell-tale or repeater of the home signal? Is it intended to protect the rear end of train after the train has passed it? Or is it intended to combine all of these functions?

If the first definition of the distant signal covers all of its functions, then a fixed signal would meet the necessities of the case, and if it is intended not only as a marker, but as a tell-tale, then it should work with the home signal, following its position; but if its functions include the last duty of protecting the rear of trains, it must be of necessity worked independent of the home signal.

The theory of the working of the distant signal in connection with grade crossings does not seem to follow the actual working as generally manipulated. The question seems to be: Can the distant signal as operated fill all the functions of a marker, a tell-tale or repeating signal, and a protection for the rear end of the train? We believe that it can fulfill all of these requirements, but in few cases have we found that it is so operated, and for the reason that it lies within the power of the operator to change its functions it sometimes becomes a dangerous signal.

There are two cases known to us where it has been conceded that the wrong use of the distant signal caused disastrous accidents; these cases are well known to those who have followed closely the record of accidents, but it is likely that the significance of the results has not been brought to the attention of all interested in following this subject, and a brief description of the case in point may be of interest.

The operator, notwithstanding strict orders to the contrary, set the signals for the train next on the schedule, he then proceeded to fall asleep, and was suddenly awakened by the sound of a locomotive whistle. The sudden awakening from sleep on duty naturally confused the man, and without pausing to take in the situation he reversed the signals, which stood at clear, and gave the signals to the opposing route, where he could see the headlight of a train approaching the crossing. He failed to observe that a train on the first route, acting under the signals displayed by the operator before he fell asleep, had passed the distant signal and was near the home signal. The home signal was suddenly put to danger, the derail opened, and the advance signals set for the opposing route. The engineer of the first train had but a few feet in which to check his train before the signal and derail were passed, the distance being altogether insufficient to stop. The train continued on the ties, stopping with a portion of train covering the crossing. The opposing train advancing under the proper signals given by the operator, plunged into the derailed train at the crossing, with the usual disastrous results; and the measure of damage amounted in one case to $20,000. It appears in these cases and others, of which we have record, that the distant signal was an instrument which in the hands of a careless operator proved a decoy. Had the operator left all signals normal before retiring for the night, it is likely that this accident would not have occurred, and yet even had all signals been left at danger it might have occurred.

It may be held by some that the accident is not directly chargeable to the changing of the signals, and consequently the operator's acts were not blamable, for the reason that all trains should approach the home signal under control, expecting to find the home signal at danger. The word control as generally applied refers to the brake power at command and the distance within which a train can be stopped. The engineer must calculate at stopping at any point between the home and distant signal. We will suppose that the engineer was prepared to bring his train to a stop before reaching the home signal. At the last point in advance of the home signal which was sufficiently distant to allow him to stop his train before passing the home signal, he observes that the home signal still remains at advance, and he continues toward the crossing. Suddenly he finds the signal against him, but he has not now sufficient distance in which to stop his train, and he must in consequence pass the home signal at danger. The engineer now claims the signal was changed from safety to danger while his train was too near the signal to be stopped before passing the signals, and the operator sets up a counter claim that the engineer should have calculated on stopping for the home signal, and that the signal was not changed at a time when the train was too close to it to be stopped before passing the signal. This being the situation, where are we to look for evidence as to whether the operator or engineer is correct in his statement? And more important still, how are we to avoid repetition of such disasters?

We may insure safety by taking the power of changing signals from the operator after a train has entered the limits of interlocking by electric locking, through the agency of a rail circuit, or by some mechanical device operated by the movement of the train. This plan is open to objection, as it would tie up the plant in case an engine or train found it necessary to stop between the crossing and the distant signal. It would also materially increase the cost of construction and maintenance. But without the presence of some means of insuring the proper manipulation of the distant signal, it becomes the loose end of the whole scheme, by which the efficiency of the whole may be destroyed, and it cannot properly be considered to be more than a marker to indicate the approach to a crossing, or for the protection of the rear end of a train within the limits of the interlocking.

It may serve a useful purpose without being an element of danger if its signal was confined to the danger position; that is, if the following rule governed:

> The distant signal is placed — ft. from the crossing for the purpose of notifying trainmen of the approach to the limits of an interlocking plant, and in no case must be accepted as indicating the position of the home signal, except when the home signal is set at DANGER, in which case the distant signal may be considered as being an index of the home signal, or as protecting the rear end of a train that is within the limits of the interlocking. THE DISTANT SIGNAL MUST NOT BE PASSED WHEN IN THE DANGER POSITION.

In case a junction point intervened, where the home signal carried two blades, the distant signal would be required to work with either blade of the home signal.

As a signal must have two positions to be effective, in all cases where it is not operated it ceases to be a signal and becomes a sign, with the same meaning at all times. Consequently, if it is not desired to work distant signals from the tower and it is still desired to have some index to the plant it might be well to fix a warning post, showing a colored light by night.

This warning post would then simply indicate the distance to the home signal, and the home signal would be the only signal for the observance of the trainman, and he would receive no false instructions concerning it. A valuable adjunct to the home signal is the automatic torpedo signal placed in advance of the signal according to the length of the trains run, and the distance required for stopping. By means of this device a torpedo is placed in position where it will be exploded by the wheels of a passing train when the signal it represents is set at danger.

In case the signal is returned to the clear position before the train passes the torpedo, then the torpedo is removed to a position where it cannot be exploded by passing wheels.

AREA NEEDED FOR SEWAGE DISPOSAL BY IRRIGATION.*

By Geo. E. Waring, Jr., M. Inst. C. E.

An acre of land contains 43,560 sq. ft. To fit a field for sewage disposal it is desirable that it should be drained, naturally or artificially, to a depth of at least 5 ft. (6 ft. would be still better). Almost any soil so drained will contain at least 30% of voids, filled with air and available for the admission of water; that is to say, the voids of an acre of land, drained to a depth of 5 ft., will admit about 480,000 gallons of water.

For proper purification it is desirable that the water should occupy about six days in its descent through the 5 ft. of depth. The daily dose required for this would be about 80,000 gallons. If the area is divided into three sections, for alternate use, the daily dose for each would be 240,000 gallons per acre. On an average the upper 6 ins. of cultivated land has not far from 50% of voids, equal to, say, 160,000 gallons per acre. The rate of descent through the ground being 10 ins. per day, the descent of the two days of rest would vacate the voids of 6 ins. of surface and of 14 ins. of subsoil. In this latter, the capacity of the voids, at 30%, would equal about 115,000 gallons, making the total space available for absorption sufficient for 275,000 gallons. This would be the theoretical capacity for such a soil with such a rate of filtration. Probably any soil that would be taken for irrigation would, after thorough underdrainage, and after sufficient use to develop its best porosity, become capable of allowing water to descend through it at the rate of 5 ft. in six days. Few soils have so little as 30% of voids.

In the above calculation no account is taken of evaporation, which is constant and, during the growing season, very large. Marie-Davy found in his experiments with the filtration tanks of Paris that of 24,000 cu. m. (6,341,000 gallons), of sewage applied in six months only 1,600 cu. m. (422,720 gallons) reached the underdrains (less than 7%.—Ed.), all the rest being evaporated from the surface of the ground and by the leaves of the crops.

The Sewerage Committee of the British Association reported in 1871 on experiments conducted by them at Bretons's Farm (Romford) "under such conditions as would insure the collection of the whole of the effluent water" to determine the amount of evaporation. The observation covered more than a year (399 days). The average amount of sewage pumped onto the farm per day was 1,182 tons. The average rainfall was 695 tons, making an average daily application of water equal to 1,877 tons. "The average amount of effluent water discharged was found to be 513½ tons per diem." That is to say, in a moist climate, in an examination which covered a whole year and the wet month of March besides, of all the water reaching the farm as sewage and as rain, 72.65% was evaporated from the surface of the ground and from the leaves of vegetation. It would seem, therefore, that it may be assumed that land which is at all suited in its original composition for sewage irrigation and is properly prepared for its work, will transmit or evaporate 80,000 gallons per acre per day, if the sewage is so applied to it as to reach all parts of its surface with sufficient completeness. At 60 gallons per head, this would be the product of a population of 1,333.

This capacity would not be reached by very heavy soils, but it would be more and more nearly approached as continued use improved the absorptive power and the drainage of the material forming the subsoil. On the other hand, it might well be exceeded with many kinds of soil, of which the voids amount to more than 30%. It is to be understood that we are still considering theoretical capacity.

In order to estimate properly the duty to be imposed on an irrigation field it is necessary to de-

* In Engineering News of Jan. 4, 1894, there was published an article by Mr. Waring on the "Partial Purification of Sewage."

termine the volume of sewage to be dealt with and the uniformity or irregularity of its daily flow. With great variations in this regard, close calculation as to area is not possible. The advantage of uniformity is so great, and the cost of all disposal is so considerable, that engineers are fast coming to the conviction that, wherever irrigation, filtration or chemical precipitation is to be resorted to, the separate system of sewerage should be adopted, excluding all storm water from sewers of which the flow is to be treated. If this is done, and if even the most casual effort is made to prevent waste of water, 60 gallons per head per day, being more than twice the average use of any mixed population, will be an ample allowance for the amount of water that will find its way to the sewers. It is therefore assumed that where sewers are to be built in conjunction with any form of artificial disposal the separate system will be adopted. If the combined system is used, another basis of calculation must be taken.

When we study practical work abroad, we see that by far the most numerous instances of irrigation treatment, of which records are available, are those where the sewers are on the combined system. Even what are called "separate sewers" in England are meant to carry a large volume of rainwater, usually all that falls on the back roofs and paved courts, and often much more; so that, during storms, the volume of discharge is several times multiplied. The application, therefore, of foreign experience to results to be expected where the entire exclusion of rainwater prevails, as in this country, must be made with care and even then we shall be able to deduce only probable inferences, rather than trustworthy indications; but in formulating practical work we must give ourselves the benefit of the doubt and avoid too close figures. It is as important to the town as to the engineer that the margin for safety be not lost sight of. The provision of land should always be well beyond what existing experience and an estimate of the volume to be treated may indicate as safe. At the same time, to spend money for an unnecessarily large area is neither good engineering nor good business, unless with a view to profitable farming. In making computations as to the relative cost of the different methods of disposal it is inexcusable greatly to overestimate the area needed for irrigation and to decide from this estimate that irrigation must be discarded and a more costly and less effective process adopted.

There is no "rule" as to the area required. From the point of view of the sewage farmer, the more the better. From the point of view of the engineer, so much as is really needed and not very much more. Sewage disposal by irrigation is much more widely used in England than elsewhere and it is natural that we should be influenced by English practice in regulating our own works. The English notion, that one acre of land should be furnished for each 100 of the population, has been accepted here as a safe precedented limit. This is all right when that area can as well as not be had, but its acceptance has subjected more than one town to a heavy outlay for chemical precipitation, when a correct estimate of the needs of the case would have given it the benefit and economy of irrigation.

England is a rainy land, and farmers are often troubled to ripen and save their crops with only natural conditions to contend with. At such times, even the amount of dry weather flow of the sewers would be only an added difficulty. The combined system increases it occasionally, and in the wettest weather, "by 50 or more times," and the separate system (vide Santo Crimp) by 11 times. Under these conditions the demands of "sewage farming" call for a wide extension of land.

Gray, in his table of statistics, gives the following instances of larger rates than 100 per acre: Bedford, 142; Croydon, 144; Dantzic, 250; Breslau, 400. These are all cases where there is a large increase of volume during rain. At the London Sewage Farm, at Barking, according to the calculations of Mr. Morgan, the manager, "the sewage of no less than 335 persons was poured over every acre."* At Merthyr-Tydvil, in 1888, with good agricultural results, the 262 acres of irrigation land disposed of the sewage of 100,000 persons, or 382 per acre. At times, for weeks together, the 20 acres of filtration area at Troedyrhiew took care of the sewage of 40,000 population, or 2,000 per acre. Eliot C. Clarke, M. Am. Soc. C. E., says that, at the State Penitentiary at Concord, Mass., 80,000 gallons were taken up by ¾ acre of gravelly soil. At 60 gallons per head, this would be at the rate of over 1,750 per acre. Dr. Alfred Carpenter, contemplating much storm water flow, says that there should not be less than one acre for 250 population. The farm at Wrexham, which, with that at Bedford, was awarded the first prize of the city of London, and where storm water is considerable, has one acre to 166 of population. At Swanwick, 15 acres of clay soil take, in addition to storm water, the sewage of 4,000 persons, or one acre to 266. In connection with the sewage purification works of Paris there are four experimental tanks, each 33 × 28 ft., containing about 6 ft. in depth of earth taken from the irrigation grounds. These received for six months' sewage at the rate of 232 persons per acre, only 6.6% escaping through the drains, which indicated that much more might have been taken. Sewage has been applied at Gennevilliers at the rate of 100,000 cu. m. per annum per hectare, which is at the rate of one acre for 487 of the population.

In most of the instances referred to above, the sewage is spread over the surface of the ground. The use of the "ridge and furrow" system, where it is run into trenches, between narrow beds on which plants are grown, affords an easily controllable method of treatment. It may be suitably so arranged that the channels for sewage, filled to a depth of 1 ft., should hold 100,000 gallons per acre, or, one-third of an acre filled every third day, 33,000 gallons, or the sewage of 550 persons per acre. This is the method adopted at Gennevilliers, where the amount of sewage applied is regulated solely by the economic needs of the cultivators. They have no obligation to take for the sake of purification more than they require for their crops. Yet, under these conditions they sometimes use it at the rate of nearly 500 persons per acre, and, on the average of the whole year, at the rate of more than 150 per acre.

One conclusion has been at last reached, even in England; it is that the return to the town from farming is of very secondary consequence, and that this consideration should give way to the requirements of purification. This is the sole standard considered in this paper. The greater incidental return we can get from the fertilizing value of sewage, the better, of course; but, as towns are generally situated, this should have little weight in the regulating of these works. It is assumed that the controlling purpose is to secure a proper disposal of the organic wastes of the population, and that these are diffused through only the water that has been used by the people, all rain water being excluded from the sewers, save so far as infiltration from the subsoil cannot be excluded by the most careful construction. In fixing the amount of sewage to be treated at 60 gallons per person per day it may be assumed that the extending use of water meters and of other precautions against waste will at least offset any increase of actual use of water in such a way as to reach the sewers. As the amount of sewage applied approaches in volume that which is contemplated in intermittent filtration, the population increases largely, until, if all idea of agricultural return is abandoned, it is safe to depend on one acre for a population of from 1,000 to 2,000, according to the porosity of the soil.

One condition must be assumed; that is, that when works for land disposal are completed and put in use, they must be constantly taken care of in a workmanlike manner. This requirement is even more imperative with chemical precipitation, which is economically managed only with something approaching scientific control. The requirement is not considered an argument against the use of this method and the similar outlay needed for the proper management of irrigation grounds must not be withheld. Care is necessary at every point, especially to see that every square yard of the area in use is absorbing its due proportion of the flow. This calls for the fidelity and skill of an intelligent laborer, one who is fully imbued with the idea that "a stitch in time saves nine" and that nothing must be put off till to-morrow that needs to be done to-day.

To come now from the theoretical to the practical and to keep well within the demonstrated limit it is safe to assume that, according to its capacity for absorption, a well-regulated irrigation field will, without precluding the possibility of a considerable return in crops, absorb and purify the sewage of a population of from 250 to 500 per acre; and that, as cropping is put more and more into the background, the population to the acre may be increased until, in the case of porous but fine, sandy soils, it reaches from 1,000 to 1,500 per acre.

If clarification, rather than purification, is the object, then these limits may be considerably raised.

The importance of a practical consideration of the degree to which the assumed limit of 100 persons per acre may be safely exceeded is illustrated in the case of Canton, O., where, in a calculation of comparative cost, it was assumed that for broad irrigation it would be necessary to buy 300 acres of land at $300 per acre ($90,000). As the separate system of sewage is used at Canton, from 60 to 120 acres would suffice for all reasonable future provision. For the population at the time (12,000) 25 to 50 acres would have been enough with complete purification. As it was a case where the effluent of chemical precipitation would satisfy the requirements of the situation, even less land would have answered.

A still more marked case was that of Providence, where it was assumed by the city engineer, and the assumption was accepted by the board of consulting engineers, that every 100 persons must have their acre of land, not minding whether it were a clay bed or a sand bank, and that as the future population to be provided for (at 60 gallons per head) would be 300,000, not less than 3,000 acres could be depended on for the necessary purification. The land available, either at Seeconk, or at Warwick, is in all respects admirably suited for irrigation, and would easily take care of the sewage of 500 per acre, requiring for the future population only 600 acres. Irrigation disposal was discarded because there were only 2,200 acres at Warwick and less than 1,200 acres at Seeconk.

Similar use is occasionally still being made of this standard of one acre for 100 of the population and towns are therefore losing the advantage of irrigation disposal.

* Journal of the Royal Agricultural Society, 1871, p. 404.

A pneumatic tube service has been put down in Chicago to connect the City Hall, Central Police Station and the office of the City Press Association with the various newspaper offices and telegraph companies. The conduits are in nests of 20 and are made of vitrified clay pipes, square on the outside and lined in the center by 2⅞-in. seamless drawn brass tubes. The conduits are laid in and surrounded by Portland cement, from 8 to 10 in. thick. Each brass tube is tested to 1,000 lbs. hydrostatic pressure at the factory. The carrier is made of flexible leather, with an inner spiral frame to keep it in shape and permit it to pass curves readily, and 2¾ in. in diameter and 8 ins. long. A band of soft fur around each end of the carrier makes it fit tight. The air is exhausted from the tube in front of the carrier and it is forced to its destination by atmospheric pressure. Moisture in the tube is removed by an electrical contrivance invented by Mr. Charles H. Wilson, of the Chicago Telephone Co. The aggregate length of the tubes laid is 15 miles.

CONSTRUCTION NEWS.

(Readers are invited to contribute items concerning new construction of interest to engineers or contractors for insertion in these columns. Those using these pages for information are informed that announcements of calls for proposals are inserted but once, and are not repeated from week to week.)

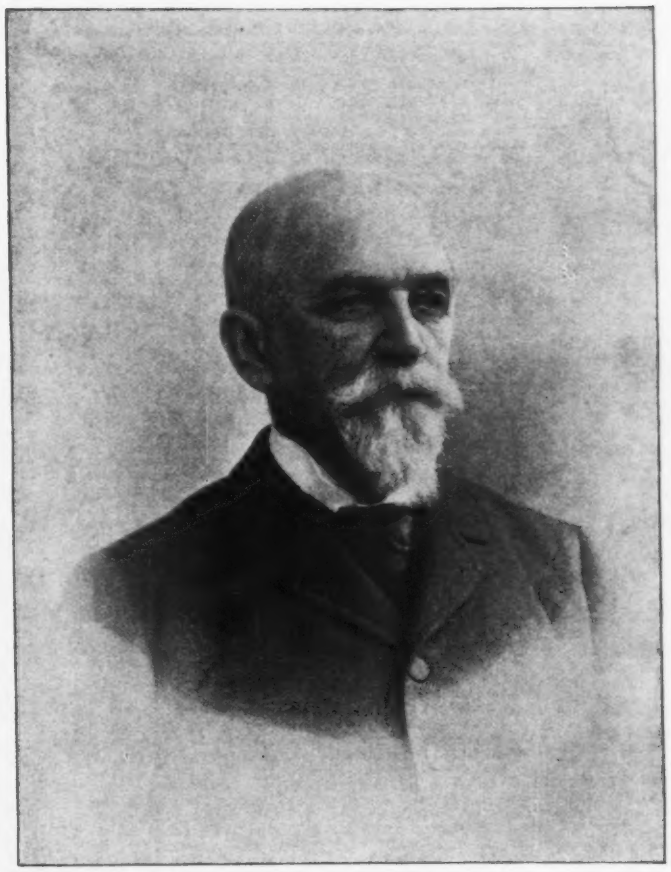
RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & OHIO.—It is reported probable that the State Line branch, from Uniontown, Pa., to Morgantown, W. Va., will be opened for passenger traffic this week. The road reaches extensive coalfields.

PENNSYLVANIA.—In opposing the bill transferring $53,000 from the Elkton & Middletown to the Elkton & Southern projected road, a representative of this company is reported as stating that this company will commence within five months the construction of a railway from Elkton, Cecil county, Md., to Massey's, in Kent county. This would parallel the proposed Elkton & Southern.

PHILADELPHIA & DELAWARE COUNTY.—A correspondent writes us that a connection has been made with the Central Division of the Philadelphia, Wil-



Very truly yrs
Wm P Craighill

mington & Baltimore just west of Fernwood, Pa., and track laid as far as Marshall Road, 1¼ miles. A train is now at work distributing ties, rails and ballast. When completed the road will be 9.9 miles long and extend to Newtown Square. It will be operated as part of the Central Division.

Projects and Surveys.

BALTIMORE & NORTHERN.—Reports state that the $1,000,000 of capital stock of this company has all been subscribed for. The company was incorporated by Wm. Gilmore, S. J. Poe, Baltimore, and others, to build a railway about 135 miles in length.

CHICAGO, UNION CITY & CINCINNATI.—A correspondent writes us that the press reports concerning this road are not correct, but that the contract for the complete construction of the road has been awarded to J. J. Shaffer, Chicago, and the only delay in the construction is in the matter of funds. About 10 miles of the right of way remains to be obtained. A subsidy of $180,000 has been secured and mortgage bonds are now being negotiated. Secy. and Treas., G. W. Patchell, Union City, Ind.

EASTON & ELKTON.—Incorporated in Maryland to build a railway from Easton to Chestertown, 37 miles; capital stock, $200,000; incorporators, Jos. B. Seth, Jas. A. Pearce, S. C. Rowland, T. Tunis, Wm. R. Martin. This is reported as a Baltimore & Eastern Shore extension.

HINESBURG & BURLINGTON.—Frank O. Sinclair, Burlington, Vt., has made surveys for a suburban railway for freight and passenger traffic between Burlington and Hinesburg, Vt., a distance of about 12 miles. The survey shows a line favorable for construction and operation and it is quite probable that a company will be organized to build the road, which would be operated by steam power.

KINGSTON, SMITH'S FALLS & OTTAWA.—Engineers have completed a survey for this railway from Kingston, Ont., to Elgin, 34 miles, and it is reported that the contract for rockwork at Blakes has been awarded.

LACKAWANNA, CATSKILL MOUNTAIN & BOSTON.—The projectors of this railway from Deposit, N. Y., to Rotterdam Junction, in the Mohawk Valley, are said to have spent $50,000 to $75,000 recently for surveys and right of way, and E. L. Jenks, Engr., is reported as stating at Delhi, N. Y., last week that if the right of way would be guaranteed to cost not more than $1,500 a mile that ground would be broken at once. The road is projected by Simpson & Watkins and would traverse about 50 miles of coal country now without railway facilities. Benj. S. Harmon, 45 William St., New York, is attorney for the railway company.

SHORT LINE IMPROVEMENT CO.—Press reports state that corps of engineers of this company are surveying for a new trunk line between Pittsburg, Pa., and New York. The projected line uses the Delaware, Susquehanna & Schuylkill and the Central Pennsylvania & Western (which road is said to have been acquired by the company) as connecting links, and connects with the Delaware, Lackawanna & Western at Stroudsburg for New York.

SOUTHBRIDGE, STURBRIDGE & BROOKFIELD.—Bids are asked until March 9 for the graduation, masonry, bridge and other work for the construction of this railway in Massachusetts, 13 miles in length. Pres., F. D. Fisk, 87 Milk St., Boston.

WASHINGTON & CHESAPEAKE BEACH.—We are informed that active preparations are being made to construct this railway, noted Jan. 25.

Southern—Existing Roads.

ALTAMONT & MANCHESTER.—It is reported that this railway will be extended six miles. Secy., A. M. Crooke, Altamont, Ky.

BALTIMORE & OHIO.—Press reports state that an extension from Lexington, Va., to Roanoke, is being considered.

CHESAPEAKE & OHIO.—Surveys are being made for a proposed branch up the Guyandotte River into the Logan county oilfields, in Virginia.

NORFOLK & WESTERN.—The commissioners of the District of Columbia are considering a bill authorizing an extension of this railway in the district.

TENNESSEE CENTRAL.—A correspondent writes us as follows: The locating party of this railway reached Crossville, Tenn., Feb. 2, and will push on toward Rockwood, Roane county, at once. J. H. Connor & Co., who have the contract for building the road, have a large force of convicts at work and are rapidly pushing the grading. The first 10 miles is nearing completion, and at an early day they will begin laying track. The stockades for the safekeeping of the convicts are being put up ahead of the grading, and one has just been constructed at a point a few miles out from Crossville. All necessary rails and material have been purchased, and will begin to arrive during this month. The road will be laid with 60-lb. steel rails and all equipment will be first-class.

WHEELING & ELM GROVE.—It is reported that this railway will be extended in the spring from Elm Grove, W. Va., to Triadelphia, seven miles.

Projects and Surveys.

PENSACOLA & NORTHWESTERN.—The contract for grading 45 miles of this railway, projected from Pensacola, Fla., to Memphis, Tenn., is reported to have been awarded. Address S. N. Van Praag, Pensacola, Fla.

RICHMOND & MANASSAS.—Eppa Hunton, Jr., B. F. Crump, J. W. Brown, C. E. Wingo and Geo. Mason have applied for a charter for this projected road in Virginia.

RICHMOND & NORTHERN.—This company has been organized by A. Y. Stokes, Jr., C. R. Sands, H. A. Williams, Simon Cohen and others to build a railway from Richmond, Va., to the Potomac River in King George, Westmoreland or Northumberland county; capital stock, $500,000.

Northwest—Projects and Surveys.

WISCONSIN & MICHIGAN.—The Marinette, Wis., "Eagle" states that John Bagley, Pres., has contracted for steel rails for 70 miles of road, and that the construction will probably be commenced as soon as the weather permits.

Southwest—Existing Roads.

TEXAS.—It is reported that J. L. Long will make the survey for a proposed railway from Rusk, Tex., west to the International & Great Northern at or near Palestine. This line will be a continuation of the road now being built from the penitentiary at Rusk to timber lands a few miles from that town. This road has been graded for about three miles, and at present 100 convicts are at work on it.

Projects and Surveys.

GULF, KANSAS CITY & SABINE.—Press reports state that this company has been granted authority to build bridges over the Neches and Sabine rivers in Texas and Louisiana.

INDIAN PACIFIC COAL & RY.—This company has been incorporated in West Virginia, according to reports, and has petitioned for authority to build a railway from Polk county, Ark., through the Choctaw country and Oklahoma, at least 100 miles of road to be built within three years.

KANSAS, OKLAHOMA CENTRAL & SOUTHWESTERN.—It is reported that the construction of this proposed railway will soon be commenced at Coffeyville, Kan. At a meeting at Perry, Okla., Feb. 2, Robt. Martin was elected president and S. M. Porter, J. R. Clark and Robt. Lowry directors.

SAN CARLOS COAL.—It is reported that the San Carlos Coal Co., Pittsburg, Pa., will build a railway 26 miles long to develop coal lands in Texas, the company having contracted to furnish the Southern Pacific with 115,000 tons of coal annually.

Rocky Mt. and Pacific—Existing Roads.

FLORENCE & CRIPPLE CREEK.—Wm. E. Johnson, Pres., is reported as stating that 1,200 men are now employed on the grade of this road to Cripple Creek, Colo., and that 1,000 more were to have been added last week. Tracklaying is progressing rapidly.

GILA VALLEY, GLOBE & NORTHERN.—A correspondent writes us that Wm. Garland, Los Angeles, Cal., has commenced the construction of this standard gage railway, noted Feb. 1, from Bowie Station, Ariz., to Globe, Ariz., 130 miles. A. L. Jones is engineer in charge.

GREAT SALT LAKE & HOT SPRINGS.—It is reported that arrangements have been completed for extending this railway about eight miles from its present terminus. Gen. Man., S. Bamberger, Salt Lake City, Utah.

MIDLAND TERMINAL.—Press reports state that the portion of this road built as narrow gage will be widened immediately, and that a new contract has been signed calling for the completion of the entire road to Cripple Creek, Colo., at the earliest possible date. About 500 additional men will be employed at once and it is expected that the road will be completed to within 2½ miles of Cripple Creek next month.

Projects and Surveys.

BLAINE & EASTERN.—J. M. Wiestling, Seattle, Wash., is reported as representing Eastern capitalists who have become interested in this projected railway from Blaine to Sumas, Wash., 22 to 25 miles. The line has been surveyed from Blaine to Lynden.

CEDAR CITY TERMINAL.—Incorporated in Utah to build a railway from Cedar City up Coal Creek canyon about 10 miles; capital stock, $200,000; Elias Morris, J. E. Langford, Chas. Wilckens and Arthur Winters, Salt Lake City; W. W. Cluff, Coalville, Utah, and others.

Foreign.

INTEROCEANIC.—Press reports state that this company will extend its line from Chiantla, Mex., to the port of Acapulco, on the Pacific coast, the construction to be commenced this month.

MEXICAN WESTERN.—A subscriber has sent us the following letter: In your issue of Jan. 18 there is an item about the Mexican Western Ry., stating that according to press reports the construction work is being pushed. I know you want to publish facts when you can, and so I write you the following: A man whom I believe to be perfectly reliable arrived here to-night from Topolobampo. I showed him the dispatch in question and asked him for the actual conditions. He said that they had been trying to work on the railroad for three years past. That about six months ago they got a steam drill which they tried to work for two weeks and then gave it up. From the time the steam drill was abandoned up to two months ago one man worked by himself, but since that time no work whatever has been done. He also says that they claim four miles of grade completed from the bay, but that this is a wagon road; that all they have done is some 50 ft. of a 10-ft. rock cut (I think that his estimate of work done is probably too small, but they have evidently done but little). These statements have been corroborated by several who have come from there. In the whole Topolobampo colony there are now some 160 or 170 men, women and children—probably about 70 men.

STREET AND ELECTRIC RAILWAYS.

WESTFIELD, MASS.—The Highland St. Ry. Co. has been organized to build an electric railway to Woronoco park, 2¼ miles distant; capital stock, $12,000; R. D. Gillett, R. B. Crane, D. L. Gillett and others.

KINGSTON, N. Y.—Press reports state that steps are being taken to build an electric railway for freight and passenger service between this city and Ellenville, N. Y., 28 miles. Meetings have been held in several villages where the scheme has been agitated, and committees have been appointed to secure the right of way.

HOMESTEAD, PA.—The council has awarded franchises to four rival companies, according to reports.

LANCASTER, PA.—A press report states that the Pennsylvania Traction Co. has acquired control of two additional electric railways in this city and now controls all the lines in this county.—The council of Downington has granted a franchise to the Pennsylvania Traction Co. for right of way through the borough for its proposed electric railway to connect Harrisburg and Philadelphia.

PHILADELPHIA, PA.—The Cherry St. Passenger Ry. Co., capital stock $12,000, and the East Snyder Ave. Passenger Ry. Co., capital stock $6,000, have been incorporated. Pres., Henry C. Moore, 624 North 22d St.

NEWPORT NEWS, VA.—J. A. Watkins, Geo. Booker, M. Armstrong, R. M. Booker, C. T. Holtzclaw and others have applied for a charter for the Buckroe, Phoebus & Newport News R. R. Co.

PETERSBURG, VA.—Capt. Thos. Pamill has applied for a franchise for a street railway in this city.

RICHMOND, KY.—A bill has been introduced in the legislature to incorporate the Manchester & Petersburg Electric Ry. Co. to build a railway between the places named; capital stock, $30,000; Wm. H. Palmer, T. W. Pemberton, T. M. R. Talcott, G. H. Jewett, A. B. Mason.

WOOSTER, O.—The council has voted to extend the time for completing the electric railway for which B. M. Barr, Cleveland, has a franchise.

GAS CITY, IND.—The Marion St. Ry. Co. has been granted a franchise to build a street railway in this city.

WAUKEGAN, ILL.—The Waukegan Electric Ry. Co. has been incorporated by M. C. Van Fleet, B. L. Jones and W. C. Palmer; capital stock, $500,000.

SAN FRANCISCO, CAL.—A press report states that the stockholders of the Market St. Consolidated Ry. Co. has voted to issue $17,000,000 of 40-year 5% bonds.

WINDSOR, ONT.—The Sandwich, Windsor & Amherstburg Electric Ry. will soon be extended from Walkersville up the river front to the Pillette road, opposite Belle Isle, according to reports.

SYDNEY, N. S.—Notice is given that application will be made at the next session of the legislature for a charter for the Boynton Bicycle Electric Ry. Co. of Canada to construct a bicycle electric railway from Winnipeg, Man., to the Port of Louisburg, N. S.

ELEVATED RAILWAYS.

PHILADELPHIA, PA.—The council is considering an ordinance granting a franchise to the Market St., Richmond & Frankford Elevated Electric Ry. Co.

WASHINGTON, D. C.—Wm. E. Earle, B. Robinson, J. F. Vinal, H. A. Taggart and others have petitioned for a charter for the Boundary & National Park Elevated R. R. Co.

MONTREAL, QUE.—The Montreal Belt Line Elevated Ry. Co. is reported as maturing its plans for the early construction of its proposed road. It is said to have received an offer from the Carnegie mills to supply the necessary rails at $20 per ton, delivered in this city.

HIGHWAYS.

MARYLAND.—The Rockville & Bethesda Turnpike Co., of Montgomery county, has been incorporated, capital stock $35,000, by W. H. H. Allen and S. D. Lincoln, Washington, and J. N. Kelly, Aug. Burgdorf and Johnson Hellen. The road will be 12 miles long, and the continuation will probably be commenced at once under the supervision of W. H. H. Allen.

MICHIGAN.—Gladwin county will vote on the adoption of the county road system at the April election.

MISSOURI.—The farmers of Buchanan county have petitioned for authority to spend $50,000 for improving the county roads. It is stated that adjoining counties will petition for similar improvements.

BRIDGES AND TUNNELS.

WEST TROY, N. Y.—Bids will be received at the Watervliet arsenal until Feb. 20 for a wrought iron or steel riveted lattice highway bridge over the Erie Canal. Maj. Isaac Arnold, Jr., U. S. A.

PITTSBURG, PA.—The house committee has reported favorably the bill authorizing the Glenwood Highway Bridge Co. to construct a bridge across the Monongahela River. The bill provides for a center span of 500 ft., with a height of 53 ft. above low water mark.

KNOXVILLE, TENN.—The council of West Knoxville is reported to have appropriated $40,000 for iron bridges.

CINCINNATI, O.—A bridge is to be constructed over Mill Creek on Spring Grove Ave.; estimated cost, $70,000.

CHICAGO, ILL.—The R. D. Wheaton Bridge Co. has been incorporated in Michigan; capital stock, $50,000.

MILWAUKEE, WIS.—The council has voted to award the contract for the superstructure of the Sixteenth St. viaduct to C. L. Strobel, Chicago, at $182,000. The bids were published Dec. 7.

MANKATO, MINN.—Bids are asked until March 6 for the construction of an iron bridge across the Little Cottonwood River. Chas. Graff, Chn. Comrs., Cambria county.

TACOMA, WASH.—The lowest bid for the Eleventh St. bridge was that of H. Cruse, representing the San Francisco Bridge Co., at $91,900; estimate, $115,000.

DRAYTON, ONT.—Bids are asked until Feb. 20 for the construction of a bridge over the Connestoga River, at Main St. J. Q. Adams.

WATER-WORKS.

HENNIKER, N. H.—The board of trade is discussing the question of works.

LANCASTER, N. H.—The question of purchasing the works will probably be voted upon next month.

FOXBORO, MASS.—The commissioners have petitioned for authority to incur additional indebtedness to the amount of $10,000.

GLOUCESTER, MASS.—A mass meeting was called for Feb. 15 to discuss the question of municipal works.

HINGHAM, MASS.—The Hingham Water Co. has voted to purchase a 1,500,000-gallon pump and to lay two miles of 10-in. main; contract for work awarded to Moore & Co., Hingham.

LAWRENCE, MASS.—The city has sold $327,000 of 4% water bonds at $104,709, according to reports.

MALDEN, MASS.—The aldermen have made an appropriation for investigating the question of an additional supply.

MONSON, MASS.—C. W. Gage, Tn. Clk., writes us

that R. M. Reynolds, W. N. Flynt and E. F. Morris are members of the committee to investigate the question of works.

WALPOLE, MASS.—Geo. P. Morey, Tn. Clk., writes us that the town has refused to accept the act permitting it to construct works.

WEST BOYLSTON, MASS.—H. Houghton, Tn. Clk., writes us that owing to the uncertainty of certain questions relating to the Boston supply that the town will probably not take action to secure works for a year or two.

NEW HAVEN, CONN.—The New Haven Water Co. has voted to increase its capital stock from $1,687,500 to $2,000,000.

WATERBURY, CONN.—R. A. Cairns, Cy. Engr., informs us that the contract for doing all the work and furnishing all the material except pipe and valves on section 3 of the 36-in. conduit has been awarded to John W. Gaffney & Co., Waterbury, at $33,404. The length of the section is 19,500 ft., average cut 7 ft., and is mostly in the highway.

WOODBURY, CONN.—A. D. Warren and A. W. Mitchell are receiving subscriptions for the stock of the Woodbury Water Co., chartered a year ago, and it is stated that the construction of the works will probably be commenced at an early date. Land has been secured for a reservoir.

SCHENECTADY, N. Y.—The city has petitioned for authority to issue $315,000 of water bonds.

SYRACUSE, N. Y.—Bids are asked until March 2 for trenching and pipelaying, as stated in our advertising columns. W. H. Hill, Ch. Engr.—No bids were received for the $500,000 of bonds at 3½% and the bonds will now be advertised at 4%, according to reports. These are the last of the $3,000,000 loan.

TONAWANDA, N. Y.—The contract for the proposed extensions has been awarded to Dwyer & Huntington, Buffalo, at $36,504.

TROY, N. Y.—The bids for 12-in. pipe have been returned unopened and new bids will be received, the pipe to weigh 75 lbs. to the foot.

NEW BRUNSWICK, N. J.—The commissioners will relay at once the main to connect the power house with the reservoir, according to reports.

ALLENTOWN, N. J.—J. Herbert Shedd, Providence, R. I., is preparing plans for improving the supply.

CONFLUENCE, PA.—J. W. Brown, Burgess, writes us that this town is rendered unhealthy at times owing to the water supply, which is from wells, and that a better supply might be secured from one of the three rivers in the town if the cost would not be too great; population, 600.

MEADVILLE, PA.—The Meadville Water Co. has offered to sell its plant for $182,000, present cost of construction, or to make a 10-year contract at $20 per hydrant per year. Plans of the city engineer estimate that new works, including 26½ miles of pipe, 175 hydrants and a 6,000,000-gallon reservoir, would cost $135,000.

OIL CITY, PA.—The board has decided to erect two steel tanks instead of the proposed reservoir.

QUARRYVILLE, PA.—A. S. Harkness, Treas., Quarryville Water Co., writes us that works will be put in this spring, including reservoir; supply from springs; population, 800.

HAGERSTOWN, MD.—The water company is reported as about to secure a supply from a mountain stream, at a cost of $20,000.

OAKLAND, MD.—J. C. Dunham, Clk., writes us that no steps have been taken to secure works further than to petition for authority to issue bonds, and it is probably that the authority will not be secured.

PETERSBURG, VA.—G. B. Gill, Cy. Aud., writes us that the city will construct a dam and reservoir to cost about $50,000, the work being done by the city under the supervision of Jno. W. Hays, Cy. Engr.—Bids are being received for a portion of the 40-year 5% water improvement loan.

ROANOKE, VA.—The council has passed an ordinance requiring the water company to adopt the meter system.

ATLANTA, GA.—Press reports state that 70,119 ft. of pipe will be laid at an estimated cost of $52,140.

QUITMAN, GA.—Bids are asked until March 1 for constructing works, including pumps, boilers, 11,000 ft. pipe, etc. E. A. Groover, Chn. Com.

LEESBURG, FLA.—It is reported that the council has contracted with D. C. W. Smith and A. Westland for works.

MADISON, FLA.—The citizens have voted to issue the proposed $15,000 of bonds for works, and it is stated that a purchaser has been found for the bonds.

DONALDSONVILLE, LA.—S. Goetle, Jr., Mayor, writes us that the town proposes to lay more pipe, erect a 12 × 130-ft. stand-pipe and put in a 60-HP. boiler.

NASHVILLE, TENN.—The council has appropriated $5,000 for water meters.

ELIZABETHTOWN, KY.—R. L. Wintersmith, Mayor, writes us as follows: We wish to dispose of a franchise for water-works and an electric light plant, bids to be opened April 1. An ice plant would also do well here.

CELINA, O.—The citizens have voted for works, according to reports.

DAYTON, O.—Bids are asked until Feb. 19 for additions to the pumping station. Chas. E. Rowe, Secy. Bd.

SANDUSKY, O.—An election will be held April 2 to vote on an issue of $30,000 of bonds for extensions. A. W. Miller, Cy. Clk.

ALEXANDRIA, IND.—The council has voted to have plans for works prepared at once.

GARRETT, IND.—Chas. W. Camp, Mayor, writes us that works will probably be built in 1895.

INDIANAPOLIS, IND.—The water company is preparing to lay 20,000 ft. of extensions.

NEW ALBANY, IND.—Frank Schefold, Engr., writes us that the city, through the commercial club, proposes to have new works, plans including two 2,000,000-gallon pumps, 19 miles of pipe and a 1,000,000-gallon covered tank on top of high hill; city offers $10,000 a year for fire hydrants.

EDWARDSVILLE, ILL.—Jesse W. Starr has petitioned for a 30-year franchise, works to include six miles of mains, daily supply of 3,000,000 gallons from wells; city to pay $2,000 per year for 75 hydrants and $25 for each additional hydrant, and to have the right to purchase plant at end of each five years; estimated cost, $50,000.

GLENCOE, ILL.—The village has contracted for a supply from the Winnetta mains, and works will probably be put in as soon as the special assessments, amounting to $85,000, have been confirmed.

KIRKWOOD, ILL.—R. L. Everett, Vil. Clk., writes us that contractors are sinking a 6-in. tubular well and that plans for works are being prepared by Mr. Garrett, Batavia, Ill.

QUINCY, ILL.—MacRitchie & Nichols, Chicago, are reported as stating that works can now be put in for at least $100,000 less than when their plans were submitted, estimating the cost at $620,000.—The committee is reported as negotiating with engineers for detailed specifications for complete plant.

RUSHVILLE, ILL.—Chas. B. Griffith, Clk. Com., writes us that an engineer will soon be employed to prepare plans for works, for which $20,000 of bonds have been voted, as noted last week.

WENONA, ILL.—The citizens have voted to issue $8,000 of bonds for works.

BAYFIELD, WIS.—The Bayfield Hydraulic Co. has purchased a site for a reservoir and will put in a new pumping station, according to reports, at a cost of $50,000.

ONALASKA, WIS.—Plans for works are reported as, including pumping engine, 1½ miles of pipe and 48 hydrants; estimated cost, $15,000.

PLATTEVILLE, WIS.—An election will soon be held to vote on an issue of bonds for $20,000 to put in works.

ALTA, IA.—G. A. Proctor, Cy. Recorder, writes us that no definite steps have yet been taken for works.

BOONE, IA.—Jesse L. Hull, Cy. Clk., writes us that about 12 bids were received for proposed extensions, including 2,230 ft. 6-in. pipe, 300 lbs. pressure, 6 Beaumont hydrants, 2,000 lbs. special castings, etc., and that the contract was awarded Jackson & Moss, Fort Madison, Ia., at $1,635.

CEDAR RAPIDS, IA.—The city is reported as about to purchase the plant of the Cedar Rapids Water Co.

EAGLE GROVE, IA.—C. A. Schaffter, Cy. Clk., writes us that no works will probably be put in this year.

GRINNELL, IA.—One-half of the $30,000 of bonds voted for works are reported as having been sold.

PERRY, IA.—Allen Breed, Mayor, writes us that about 7,000 ft. of extensions will probably be laid in the summer.

TRAER, IA.—W. J. Ladd, Cy. Recorder, writes us that an engineer has been employed to prepare plans for works; population, 1,200.

PARKERSBURG, IA.—The contract for works has been awarded to the Challenge Wind Mill Co., Batavia, Ill.

WILLIAMS, IA.—Press reports state that an election was held last week to vote on the question of works.

CALEDONIA, MINN.—E. K. Roverud, Vil. Recorder, writes us that bids will be opened Feb. 28 for works to cost about $8,000, including 10 × 110-ft. stand-pipe, 3,000 ft. 8 to 4-in. mains and 7 hydrants. Engr., Tremont Turner, Des Moines, Ia.

DULUTH, MINN.—Bids are asked until Feb. 26 for $800,000 of 5% water and light bonds. C. E. Richardson, Clk.

GLENCOE, MINN.—J. L. T. Danck, Vil. Recorder, writes us that the citizens have voted to lease works and electric light plant.

HENNESSEY, KAN.—It is reported that an election will soon be held to vote on a proposition for works.

AUBURN, NEB.—Bids are asked until March 15 for works to cost about $18,000. Consult. Engr., A. A. Richardson, Lincoln. C. O. Snow, Cy. Clk.

CAMBRIDGE, NEB.—An election will be held March 6 to vote on the question of works. Engr., A. A. Richardson, Lincoln.

FREMONT, NEB.—The commissioners have recommended that additional wells be sunk at the works.

FRIEND, NEB.—An election will be held March 5 to vote on an issue of $18,000 of bonds for works. Engr., A. A. Richardson, Lincoln.

HEMINGFORD, NEB.—The following contracts have been awarded; Jas. H. Carter, Omaha, stand-pipe, $2,450; H. M. Clifford, Hemingford, foundation, $500; J. C. McCorkle, Hemingford, trenching, 6 cts. per lin. ft. The contract for pipe is noted under Contract Prices, and the bids for the rest of the work and materials were rejected. Engr., A. A. Richardson, Lincoln.

MADISON, S. DAK.—Elmer Sheridan, Cy. Aud., writes us that contracts for works have been awarded to Fairbanks, Morse & Co., St. Paul, at $28,950, the other bids being Geo. W. Sturtevant, Chicago, $30,385; C. W. Hubbard, Sioux Falls, $29,886; Glatz & Smith, Madison, $35,996; work to be commenced about March 1.—The bonds have been sold at par.

SPEARFISH, S. DAK.—It is proposed to purchase new pipe for the main between the reservoir and the spring.

FARGO, N. DAK.—The question of a better supply is being considered.

SEARCY, ARK.—J. J. Baugh, Cy. Clk., writes us that Pullen & Brown, Little Rock, are preparing to commence the construction of works at once. A 20-year franchise has been awarded, as noted Feb. 1.

BALLINGER, TEX.—It is reported that the contract for works has been awarded to M. P. Kelley, at $14,000, conditional upon sale of bonds.

FORT WORTH, TEX.—A press report states that the water-works dam across the Clear Fork of the Trinity River gave way Feb. 8 and at 12 o'clock but 3 ft. of water was left in the reservoir.

GONZALES, TEX.—The water company has ordered the purchase of a 1,500,000-gallon pump, according to reports.

KERRVILLE, TEX.—The Kerrville Water-Works Co. has been incorporated by Chas. and A. C. Schreiner, L. A. Schrebner and Nathan Herzog; capital stock, $10,000.

MARION, TEX.—A contract was awarded Feb. 7 for sinking a 6-in. artesian well to a depth of 500 ft. The city has no water-works at present.

ENID, OKLA.—It is reported that the question of works will soon be voted upon by the citizens.

PERRY, OKLA.—An election will be held Feb. 21 to vote on the question.

EVERETT, WASH.—The proposition to purchase the works will be voted upon March 31.—The water company is reported as about to extend the main from Wood's Creek to Lowell.

WINNIPEG, MAN.—Bids are asked until March 10 for a 2,000,000-gallon pumping engine, as stated in our advertising columns. E. H. Bissett, Mgr.

IRRIGATION.

FORT BENTON, MONT.—Chas. McIntyre, of this city, has been employed to prepare plans for an irrigation system for the Fort Peck Indian reservation, according to reports.

GREAT FALLS, MONT.—Jos. Carrier is reported as interested in a proposed company to sink an artesian well for irrigation purposes.

PHOENIX, ARIZ.—The Western Arizona Water Co. is reported as planning to store the waters of the Bill Williams Fork for irrigating purposes; Pres., W. S. Hutchinson; Secy., T. M. Thompson.

PRESCOTT, ARIZ.—The "Courier" states that Messrs. Snow, Storms and Dougherty propose to build a water storage dam in what is known as Big Chino Wash, and with a connecting canal reclaim 2,000 acres of land in that valley.

SALT LAKE CITY, UTAH.—A correspondent writes us as follows: It is proposed to construct a dam across the Little Cotton Wood Creek at the mouth of the canon about 13 miles south of this city, the dam to be about 60 ft. high, making a reservoir of about 30 acres, which could be increased by making the dam higher. A small dam at the outlet of a lake near the head of the canon, which will cost less than $100, will make an additional reservoir of about 100 acres. It is expected by this means to irrigate about 1,200 acres more than can be done with the natural flow of the creek, which is all utilized.

In addition to the irrigation project there is a chance to control the ice industry of the city. The melting snow furnishes a pure stream which runs over solid granite almost all the way to the proposed reservoir site. The analysis of this water shows it to be almost like rain water, containing only about four grains of impurities per gallon. The Wasatch branch of the Rio Grande Western Ry. passes within a few rods of the reservoir. At little extra expense there could be developed about 300 HP., making it a fine factory site, or the power could be electrically transmitted to Sandy, a distance of about three miles, or to this city. Messrs. J. M. Thomas and Frank Hall are interested.

SEWERS.

CLAREMONT, N. H.—The citizens are discussing the immediate construction of sewers.

BEVERLY, MASS.—Bids are asked until Feb. 24 for constructing 3,000 ft. brick sewer, including 450 ft. in tunnel, 700 ft. 40-in. iron pipe sewer, and 3,700 ft. pipe sewers; also for furnishing 288 ft. cast iron pipe, 450,000 brick, 2,000 bbls. cement, about 5,000 ft. 18 to 6-in. sewer pipe, manhole covers, etc. F. W. Cressy, Chn.

MALDEN, MASS.—The street commissioner has been authorized to issue bonds for $200,000 for sewers.

SPRINGFIELD, MASS.—The council is considering a brick and iron extension of an outlet sewer into the river.

WESTFIELD, MASS.—The city engineer has recommended an appropriation of $5,000 to $10,000 for completing the system.

PROVIDENCE, R. I.—Bids are asked until Feb. 20 for constructing about 6,000 ft. of 32 to 20-in. brick sewer, and for 20 to 12-in. pipe sewers in 19 streets, as stated in our advertising columns. Robt. E. Smith, Comr. Pub. Wks.

WESTERLY, R. I.—The question of a system is being revived.

MIDDLETOWN, CONN.—The council has voted to issue $28,000 of 4% sewer bonds.

NEW BRITAIN, CONN.—The sewer commissioner has sold $25,000 of 4% sewer bonds at 1¼% premium.

NEW YORK, N. Y.—Contracts for sewers have been awarded as follows: Bernard Mahon, at $12,720; F. Thilemann, Jr., at $5,423; W. F. Cunningham, at $7,901; M. M. Rooney, at $3,433; E. S. Vaniuhm, at $1,246; Thos. Murray, at $5,584 and $5,402; Jno. Slattery, at $1,170; Daniel Fitzpatrick, at $3,185; Riley & Mamoney, at $3,489.

CHARTIERS, PA.—Bids are asked by the council for building a 24-in. sewer in Third St.

DU BOIS, PA.—An election will be held this month to vote on an issue of bonds for a system.

MANSFIELD VALLEY, PA.—The council has authorized the street committee to secure an engineer to make surveys for a sewer in Jane St.

STROUDSBURG, PA.—It is reported that Scranton capitalists are endeavoring to secure a franchise for a system.

CUMBERLAND, MD.—The council has ordered the construction of a 3-ft. brick sewer to cost about $5,000.

RICHMOND, VA.—The council has adopted a resolution appropriating $70,000 for sewers.

AUGUSTA, GA.—Ordinances have been passed for constructing 18 to 6-in. sewers in several streets.

LEXINGTON, KY.—S. F. Campbell informs us that it is proposed to construct about 16 miles of pipe sewers, average cut 6 ft., and that bids for the work will probably be received in April. C. H. Stoll and J. R. Morton are members of the committee.

NEWPORT, KY.—Bids are asked until Feb. 22 for constructing about five miles of 6 to 21-in. sewers, as stated in our advertising columns. B. R. Morton, Cy. Engr.

CINCINNATI, O.—Bids are asked by the board of administration until Feb. 23 for a sewer in Madisonville Ave.

CLEVELAND, O.—Bids will soon be asked for sewers in about 19 streets.

TOLEDO, O.—Bids are being received, according to reports, for about 2,000 ft. of 36 and 30-in. brick sewer, average cut 22 ft.

CONNERSVILLE, IND.—A petition has been presented asking the council to proceed at once to have plans made for a complete system and to commence the construction of the most needed sewers..

INDIANAPOLIS, IND.—The contract for 1,694 ft. of sewer in Mississippi St. has been awarded to T. T. Sheehan, at $12 per lin. ft., the other bids being A. W. Conduitt, $13.93; Standard Const. Co., $14.90; W. J. Irvin, $14.25; Fulmer & Seibert, $18.07; Wilding & Derhemier, $19.43; Wm. Bossert, $15.95; W. R. Mercer, $19.40.——Plans have been approved for two local sewers.

TERRE HAUTE, IND.—Bids are asked until Feb. 20 and March 6 for constructing 15 to 6-in. pipe sewers. Chas. H. Goodwin, Cy. Clk.

BELLEVILLE, ILL.—The council is considering an ordinance providing for the construction of the proposed system.

PEORIA, ILL.—J. A. Harman, Cy. Engr., informs us that about 15 miles of sewers will be built during the year. One system, known as the Walnut St. sewer, will consist of 5 miles, ¾ mile of which will be brick, the balance 8 to 18-in. pipe. The other, known as the Spring St. system, will consist of about 9 miles of pipe, 8 to 18 in. in diameter. The two systems will drain an area of about 285 acres.

NEENAH, WIS.—S. M. Sykes, Cy. Clk., informs us that surveys are being made by Geo. W. Sturtevant, Chicago, for a system, but that no steps have been taken for the construction; plans to be completed about May 1.

EL RENO, OKLA.—A sewerage system is contemplated, according to reports.

SALT LAKE, UTAH.—The city engineer has recommended continuing the construction of the gravity sewer under the present contract. The cost to Dec. 15 was $161,907, and the entire work is estimated to cost $367,400, or $7,000 less than the estimate.

HAMILTON, ONT.—The city engineer has recommended the construction of 10,500 ft. of sewers, estimated to cost $48,650.——The committee has asked for an appropriation of $20,000 for sewers.

STREETS.

WORCESTER, MASS.—A company is reported as being formed, with a capital stock of $28,000, to build asphalt streets in this city. C. A. Richardson, of the Worcester Construction Co., is interested.

FLUSHING, N. Y.—Bonds for $34,000 will be issued to improve the streets, according to reports.

NEW YORK, N. Y.—About 150 streets are to be paved and improved to give employment to the unemployed.

YONKERS, N. Y.—The city has been authorized to issue $75,000 of railway paving bonds.

PLAINFIELD, N. J.—Bids are asked until Feb. 27 for laying crosswalks for one year, for furnishing crushed stone during 1894, and for macadamizing in Grant Ave. J. T. MacMurray, Cy. Clk.

BELLEVUE, PA.—An ordinance has been passed by the council authorizing the paving of Lincoln Ave. at an estimated cost of about $45,000.——The citizens will vote on issuing bonds for $25,000 for improving other streets.——It is thought that all the street can be paved at a cost of $300,000, one-third of which would be paid by the borough and two-thirds by the property owners.

EASTON, PA.—Bids are asked until March 1 for paving 5,470 sq. yds. with vitrified brick, as stated in our advertising columns. H. R. Fehr, Cy. Engr.

NANTICOKE, PA.—Petitions have been presented for paving Main and Market streets.

YORK, PA.—It is stated that about 13 streets will be paved if the proposed loan bill becomes a law.

BALTIMORE, MD.—Resolutions to repave three streets with Belgian blocks are before the council; estimated cost about $347,000.——Bids are asked until Feb. 23 for 1,156,000 Belgian blocks. E. A. Smyrk, Cy. Comr.

LAUREL, MD.—A public meeting is to be held on Feb. 16 to discuss an issue of $48,000 of bonds for macadamizing and improving streets.

ATLANTA, GA.—Bids are asked until Feb. 19 for paving 18,000 sq. yds. with bricks. D. G. Wylie, Comr. Pub. Wks.

LEXINGTON, KY.—S. T. Campbell informs us that it is proposed to pave about four miles of streets with brick, bids for which will probably be received in April.——The contract for improving West Sixth St. has been awarded to M. Dolan & Sons, at $4,266, the other bids being: Brasfield & Smith, $5,012; Mrs. D. Murphy, $5,987; Masner & Hayes, $4,716; James Scully, $5,526; J. M. Lyttle, $7,008; B. J. Shannon, $5,137.

AKRON, O.—We are informed that bids will be received until Feb. 17 for paving several streets with brick. E. A. Hensley, Cy. Clk.

NEWARK, O.—The council has voted to pave five streets.

PIQUA, O.—The city wishes information as to cost and best material to be used for paving Main St. C. J. Olin, Cy. Clk.

SANDUSKY, O.—The city engineer estimates the proposed paving of certain streets with brick upon 6 ins. of concrete and 2 ins. of sand with tar filling at $130,000.

TERRE HAUTE, IND.—Bids are asked until March 6 for grading and paving two streets with brick or asphalt. Chas. H. Goodwin, Cy. Clk.

BAY CITY, MICH.—Bids are asked until Feb. 19 for reparing several streets with cedar blocks. C. H. Klumph, Chn. Bd. Pub. Wks.

MOLINE, ILL.—Bids are asked until April 2 for grading and paving Third Ave. W. C. Bennett, Chn. Com.

MILWAUKEE, WIS.—The city engineer estimates that the proposed paving of Grande Ave. will cost, at $3 per sq. yd., $143,220.

ST. LOUIS, MO.—Plans have been prepared for paving Union Ave. with telford macadam. The plans include a grass plot 26 ft. wide in the center of the street, and the pavement will have a bed of cinders under the riprap and have a top dressing of crushed granite.

GALVESTON, TEX.—An ordinance has been presented in the council appropriating $150,000 for constructing sidewalks in several streets, according to plans made by the city engineer.

WINNIPEG, MAN.—Bids are asked until March 1 for supplying 500 cords of tamarac or cedar paving wood. J. C. Sproule, Chn. Com.

ELECTRIC LIGHT AND POWER.

LANCASTER, N. H.—A press report states that a company will probably be formed in the spring to build a large electric plant on Fifteen-Mile Falls on the Connecticut River, in the town of Dalton, to supply light, heat and power within a radius of 50 miles.

BRADFORD, VT.—E. O. Leonard has prepared plans for an electric light plant for eight arc lights.

BROOKLYN, N. Y.—The bids for electric lights, published in our issue of Jan. 25, have all been rejected. The mayor is reported as stating that 35 cts. per light per night would enable the companies to make a very neat profit, while the lowest bid was at 30½ cts.

MARIETTA, PA.—The Marietta Electric Light Co. has purchased a site for a plant; capital stock, $15,000.

ANNAPOLIS, MD.—The council has directed the special committee to advertise for bids by Feb. 26 for an arc and incandescent lighting plant for the city, according to plans prepared by John O. Judge.

QUITMAN, GA.—Bids are asked until March 1 for an electric light plant, including a 75-HP. engine, 500-light incandescent and 25-light arc dynamo, wire, etc. E. A. Groover, Chn. Com.

GALLATIN, TENN.—It is reported that a proposition is being considered for a plant.

PADUCAH, KY.—Bids are asked until March 15 for lighting the city for 10 years, as stated in our advertising columns. W. H. Patterson, Cy. Clk.

WINCHESTER, KY.—John P. Martin, Xenia, O., will put in a plant according to reports, the city to pay $2,600 a year for street lighting.

MASSILLON, O.—The council is considering the question of a plant for both public and commercial lighting.

OMAHA, NEB.—The city comptroller has been directed to advertise for bids for street lighting for three years. The city is at present paying $140 and $175 per year for each 2,000-c. p. arc light.

MOBERLY, MO.—R. M. Duvall has prepared plans for a $40,000 electric light plant for the city, according to press reports.

TORONTO, ONT.—The lighting estimates for 1894 include 988 electric lights at 29¾ cts. each per night and 955 gas lamps at $24 each per year, with 70 on new mains at $25.

NEW COMPANIES.—Anthracite Electric Light, Heat & Power Co., Scranton, Pa.; $25,000; Treas., Alex. Simpson.——Mason Electric Co., Chicago, Ill.; $10,000; Norman Totten, F. A. Moore, Manton Maverick.——Standard Electric Equipment Co., Jersey City, N. J.; $25,000; Jos. F. O'Day, John O'Day, New York; L. H. Schenck, Mechanic, N. J.——Metropolitan Electric Co., Reading, Pa.; $10,000; Treas., M. C. Aupenbach.——Healdsburg Electric Light & Power Co., San Francisco, Cal.; $25,000; A. H. Babcock, G. R. Babcock, D. H. Ward, A. S. Ward, all of Oakland.——El Dorado Light & Fuel Co., El Dorado, Kan.; $75,000; Rodolph Hatfield, O. H. Bentley, Hiram Burnett and others, all of Wichita.——McEvoy Electric Const. & Supply Co., Jersey City, N. J.; $250,000; E. J. and J. B. A. McEvoy, E. J. and Thos. Kenney, New York.

CONTRACT PRICES.

PIPE.—Bolivar, Mo.—Chas. F. Sturtevant, Consult. Engr., St. Louis, informs us that the following bids were received for furnishing pipe for the proposed water-works, all bids for specials being at 2½ cts. per lb.: Kercheval, Johnson & Co., Dallas, Tex., $22.50 per ton, delivered f. o. b. cars in this city; Massac Iron Co., Metropolis, Ill., $26; Ripley-Delrick Supply Co., St. Louis, $22.20; Anniston Pipe & Foundry Co., Anniston, Ala., $21.95; Chattanooga Foundry & Pipe Co., Chattanooga, Tenn., $25. The bids for the entire works were published last week under Water-Works.

New York, N. Y.—The following bids were received Feb. 6 for 1,400 tons of 48 to 4-in. cast iron pipe and 100 tons of specials, delivered at pipe works in this city: M. J. Drummond, $19.34 per ton of 2,000 lbs. for pipe and $41 for specials; Jno. Fox, $19 and $42; McNeal Pipe & Foundry Co., $20.22 and $45; Camden Iron Wks., $19.67 and $43; Warren Foundry & Machine Co., $19 and $40.

Yonkers, N. Y.—Jos. A. Lockwood, Supt., writes us that the contract for cast iron water pipe has been awarded to R. D. Wood & Co., at $21.85 per ton of 2,240 lbs., with special castings at 2 2-5 cts. per lb., the other bids being Warren Foundry & Machine Co., $22.20 and 2⅛ cts.; McNeal Pipe & Foundry Co., $22 and 2¼ cts.; bids from local foundries for special castings from 12-in. down, at 1¾ and 1¼ cts. per lb. In August, 1873, the first contract for pipe and special castings for these water-works was awarded to the lowest bidder at $57 per ton per pipe and 4 cts. per lb. for castings.

Hemingford, Neb.—The contract for pipe for the proposed water-works has been awarded to the Chattanooga Foundry & Pipe Co., at $20.40 per ton, and that for special castings to J. W. Orr, Hemingford, at 2.63 cts. per lb. Engr., A. A. Richardson, Lincoln.

LEAD, ETC.—New York, N. Y.—The following bids have been received by the department of public works: John Fox, best refined lead, 60,000 lbs., at 3.64 cts. per lb.; ¾-in. lead pipe, 2,000 lin. ft., 6,000 lbs., at 4.6 cts. per lb.; 1-in., 1,000 lin. ft., 4,000 lbs., at 4.6 cts.; best quality pot solder, 1,000 lbs., at 12 cts.; Calweli Lead Co., 3.7 cts., 4.6 cts., 4.6 cts. and 12 cts. respectively.

MANHOLE COVERS, ETC.—New York, N. Y.—The following bids were received by the department of public works Feb. 7, the total amounts being: 1, Jno. Fox, $1,840; 2, G. H. Toop, $2,933; 3, Hay Foundry & Iron Wks., $2,123; 4, Manhattan Supply Co., $3,061; 5, M. J. Drummond, $1,981; 6, Sylvester N. Leary, $2,068; 7, Maher & Flockhart, $2,768:

Quantities.	1.	2.	3.	4.	5.	6.	7.
150 manhole heads and covers, 91,500 lbs., per lb	$.01¼	$.01¾	$.01⅞	$.01⅞	$.01⅞	$.01¾	$.01⅝
175 extra manhole covers, 23,625 lbs., per lb	.01¼	.01¾	.01⅞	.01⅞	.01⅝	.01¾	.01⅝
75 basin covers, 4,500 lbs., per lb	.01¼	*1.75	.01⅞	.01⅞	.01⅝	.01¾	.01⅝
100 basin heads, each	1.50	5.00	1.85	5.00	1.70	5.00	5.00
200 basin grate bars, each	.90	1.50	1.70	1.49	1.10	.50	1.00
100 step irons, each	.15	.60	.20	.14	.15	.13	.15

* Each.

ASPHALT BLOCKS.—Washington, D. C.—The district commissioners have awarded the contract for furnishing asphalt paving tiles to the Washington Asphalt Block & Tile Co., at $53.50 per 1,000.

SEWERS.—New York, N. Y.—The following bids were received by the department of public works Feb. 7 for alteration and improvement to brick sewer in Ferry and Jacob streets: 1, Jno. Madden, $14,500; 2, Philip J. Kearns, $13,575; 3, Bernard Mahon, $11,390; 4, E. R. De Camp, $14,430; 5, Patrick Casey, $11,910; 6, Wm. F. Cunningham, $13,440, the prices being as follows:

Quantities.	1.	2.	3.	4.	5.	6.
34x60-in. sewer, 304 lin. ft.	$17	$16	$14	$16	$12.95	$16
34x60-in. sewer, 165 lin. ft.	19	16	14	16	12.95	16
30x54-in. sewer, 321 lin. ft.	17	16	13¾	16	12.95	16
Rec'g basins, old h'ds, S..	50	100	40	150	100.00	10
Culvert, 90 lin. ft.	1	1½	1	1	7.00	..
Bracings, etc., 25 M. ft.	10	...	..	20	10.00	..

Philadelphia, Pa.—The contract for repairing the Cohocksink main sewer has been awarded to Jos. McParland at $1.47 per cu. yd. for excavation, including piling, shoring, etc.; $7 per cu. yd. for rubble masonry; $11.60 per cu. yd. for brick masonry. Jas. Sullivan bid $1.45, $8.50 and $13, and Jas. A. Mundy & Bro., $1.50, $10 and $12, respectively.

Homestead, Pa.—The contract for the Seventh Ave. 15-in. pipe sewer has been awarded to Erbeck Bros., at 82 cts. per lin. ft. Dennis Murray bid 84 cts., and J. G. Taylor, $1.

BRIDGE.—Columbus, O.—John J. Dun, Co. Surv., informs us that bids were received on Feb. 9 for the 8-span girder bridge over the tracks on St. Clair Ave. The estimated weight of the bridge was 50,400 lbs. of handrail, 475,518 lbs. of iron in girders, 95,632 lbs. of I-beams, 21,000 ft. B. M. of sidewalk timber and 13,440 sq. ft. buckle plates or cambered arch. The approximate lowest bids on the superstructure for the iron-work on the girders, I-beams and handrails complete, were $16,500, including floor system of wood, $19,000. For the cambered arch and asphalt floor system $22,700, for ⅜-in. buckle plate and asphalt floor, $27,600. On these bids the asphalt floor was of the same area as the buckle plates or cambered arch. These figures are on the basis of about 2½ cts. per lb. of iron.

HYDRANTS, STOP COCKS, ETC.—New York, N. Y.—The department of public works has received the following bids, the bidders being, 1, Kennedy Valve Mfg. Co.; 2, John Fox; 3, Jonson Engineering & Foundry Co.; 4, M. J. Drummond:

Quantities.	1.	2.	3.	4.
12-in. stop cocks, 25	$26.00	$25.30	$27.50	$24.40
6-in. stop cocks, 160	11.00	10.90	11.60	11.00
Double noz. "A" hydrants, with waste cocks and guards, 50	15.00	15.00	15.35	15.00
"A" hydrants, with waste cocks, 400	13.20	13.30	14.45	12.50
"A" hydrant boxes, 400	1.65	1 71	1.65	1.60
No. 1 iron stop cock boxes and covers, 100	11.88	11.25	12.75	11.00
Manhole heads and cov., 20	7.68	7.90	10.60	9 00
1-in. tapping cocks, 100	.85	.90	.....	.90
¾-in. " " 500	.54	.61	....	.60
⅝-in. " " 2,000	.42	.43	.....	.39
Tapping cock boxes, 3,000	.68	.06½	.....	.07½
Dock hydrants, 200	9.75	10.00	10.00	8.20
Composition hyd. noz., 500	.26	.28	.40	.25
Hyd. caps and chains, 2,000	.24	.22	.40	.24
Twist drills for 1 in., ⅞-in. and ¾-in., 24 of each	.85	.94	.92	.90
Plug drills for 1-in., ⅞-in. and ¾-in., 24 of each	.93	1.10	1.00	.90
12-in. whitewood plugs, 50	1.20	1.20	.50	1.40
6-in. " " 200	.28	.28	.20	.50
4-in. " " 100	.15	.18	.10	.15
70-lb. stop cock covers, 100, per lb	.01¾	.01⅝	.02	.01¾
140-lb. stop cock covers, 100, per lb	.01¾	.01⅝	.02	.01¾
20-in. stop cock and gearing, 1	110.00	104.50	110.00	115.00
12-in. stop cock, inside service, 20	26.00	25.30	27.00	24.40
6-in. stop cock, outside service, 100	11.00	10.90	11.60	11.00
4-in. stop cock, outside service, 40	7.15	8.10	8.50	7.50
No. 1 hydrants, with waste cocks, 200	11.55	11.05	12.20	11.20
No 2. hydrants, with waste cocks, 150	11.00	11.00	11.70	10.60
"A" hydrant boxes, 700	1.65	1.71	1.65	1.60
No. 1. hydrant boxes, 700	1.54	1.71	1.60	1.60
No. 1 iron stop cock boxes and covers, 3	11.88	11.25	12.75	11.00
No. 2 iron stop cock boxes and covers, 250	8.50	8.45	9.75	9.00
No. 3 iron stop cock boxes and covers, 200	7.24	7.20	8.25	8.00

ASPHALT PAVING.—Philadelphia, Pa.—The following bids were received last week for paving with sheet asphalt: Pennsylvania Asphalt Co., Bermuda asphalt, $2.15 per sq. yd., or $1.98 with a bituminous base; Vulcanite Paving Co., Trinidad asphalt, $2.58 or $2.22

with bituminous base; Philadelphia Paving & Const. Co., Sicilian asphalt, $2.69.

GRANITE BLOCKS.—Baltimore, Md.—Bids were received last week for 550,000 Belgian paving blocks, the prices ranging from $54.50 per 1,000, for one lot of 50,000, to $69.50.

PIPELAYING.—New York, N. Y.—The following bids were received by the department of public works Feb. 6 for pipelaying, the total bids being, 1, J. S. Rogers, $7,397; 2, Martin Lipps, $7,775; 3, Jno. Cornwell, Jr., $7,965; 4, W. J. Ford, $8,716; 5, Patrick Fober, $8,477:

Quantities.	1.	2.	3.	4.	5.
Rock excav., 1,000 cu. yds..	$.18	$.27	$.25	$.20	$.20
Earth " 8,000 " ...	.18	.27	.25	.20	.20
Filling 8,500 cu. yds.	.18	.10	.25	.20	.20
Laying 12-in. pipe, 2,500 lin. ft.	.30	.60	.25	.45	.30
Laying 6-in. pipe, 16,000 lin. ft.	.16	.16	.16	.15	.20
Setting 12-in. stopcocks and boxes, 2	6.00	5.00	5.00	10.00	10.00
Setting 6-in. stopcocks and boxes, 30	6.00	5.00	4.00	10.00	6.00
Setting single noz. hydrants, A, 55	6.00	5.00	5.00	10.00	6.00
Brick masonry, 2 cu. yds ..	.01	00	00	10.00	5.00
Pavement and flagging, 300 sq. yds.	.20	00	00	.50	.40
Telford macadam, 100 sq. yds.	.50	00	00	.50	.65
Curb and gutter, 100 lin. ft.	.05	00	00	.01	.02
Boxing, 12-in. pipe, 100 lin. ft.	3.00	00	00	6.00	3.00

MISCELLANEOUS CONTRACTS AND SUPPLIES.

FIRE ALARM.—Carthage, O.—Bids are asked until Feb. 20 for a complete fire alarm system for this village. Theo. C. Frost, Vil. Clk.

PARK BONDS.—Everett, Mass.—The council has voted to petition for authority to issue $50,000 of 30-year 4% bonds for public parks.

HAND FIRE ENGINES.—Elkton, Ky.—Ben T. Perkins, Jr., writes us that he wishes prices on hand fire engines or something of that kind.

STREET CLEANING.—Indianapolis, Ind.—The board of public works will receive bids until Feb. 25 for street cleaning until November, 1895.

DAM IMPROVEMENTS.—Eau Claire, Wis.—The Dells Improvement Co. is reported as planning to make improvements at the Dells dam to cost $12,000.

PILING.—Cincinnati, O.—Bids are asked until March 3 for piling at Miamitown, Whitewater township. G. O. Zimmermann, Clk. Comrs. Hamilton Co.

WHARF.—Ottawa, Ont.—Bids are asked until Feb. 24 for constructing a public wharf at Gardner's Creek, St. John Co., N. B. Res. Engr., J. B. Hagan, St. John. E. F. E. Roy, Secy. Dept. Pub. Wks.

ELECTRICAL CONDUCTORS.—New York, N. Y.—The police department will receive bids until Feb. 20 for furnishing electrical conductors and placing them underground, no bid in excess of $33,000 to be considered.

DRAINAGE DITCH.—Imlay City, Mich.—A press report states that a drainage ditch 35 ft. wide and about 25 miles in length will be constructed in Lapeer, Sanilac and St. Clair counties; Engr., Patrick Shea, Marine City, Mich.

REMOVING OBSTRUCTIONS.—Philadelphia, Pa.—Bids will be received at the U. S. Engineer Office until March 5 for removing obstructions from the waterway along the front of League Island. Maj. C. W. Raymond, U. S. A.

GAS APPARATUS.—Port Huron, Mich.—The Port Huron Gas Light Co. has contracted with the Western Gas Const. Co., Fort Wayne, Ind., for a complete set of Lowe gas generating apparatus and will commence at once the construction of a new building to cost $12,000.

GARBAGE CREMATORY.—Allegheny, Pa.—The committee on public safety has recommended that land be purchased for the erection of a garbage furnace.

Atlanta, Ga.—The council is considering a proposition of the Dixon Sanitary Crematory Co., Findlay, O., for disposing of the garbage and nightsoil of the city.

REMOVING LEDGE, ETC.—Portland, Me.—Bids will be received at the U. S. Engineer Office until March 5 for removal of ledge in Cocheco River, N. H., also in approach to channel through Moosabec Bar, Maine; for constructing a stone breakwater at Little Harbor, N. H.; and for dredging in Penobscot River, Maine. Lieut.-Col. Peter C. Hains, U. S. A.

IRON PIER.—Long Branch, N. J.—A press report states as follows: The erection of a new iron pier here will be begun at once. It will be located about 1,000 ft. north of where the old pier stood, and will be built opposite the Madison Flats, at a cost of about $150,000. It will be mostly of iron, and about 1,000 ft. long and 50 ft. wide. It will be completed by June 1.

BUILDINGS.—St. Paul, Minn.—Bids are asked until Feb. 23 for rebuilding the administration building of the Rochester state hospital for the insane. Architect, W. B. Dunnell, Minneapolis. T. H. Titus, Secy. Bd. Trustees, Ryan Hotel, St. Paul.

Newark, O.—Bids will be received until Feb. 23 for constructing the Newark Soldiers' Memorial building. Architects, Yost & Packard, Columbus. Jonathan Rees, Chn. Bd. Trustees.

CITY HALL DOME.—San Francisco, Cal.—The following bids were received for the entire work of constructing the dome of the city hall: J. H. McKay, $230,580; O'Connell & Lewis, $221,950; Constable & Hamilton, $253,000. Separate bids for the ironwork were also received as follows: Risdon Iron Wks., $110,000; T. D. Warrick, $98,925; Ralston Iron Wks., $96,150; Western Iron Wks., $105,000; J. McMullen, $91,980; Constable & Hamilton, $90,000.

WATER POWER CANAL.—Niagara Falls, N. Y.—The Niagara County Irrigation & Water Supply Co. is reported as about to commence the construction of a water power canal from the upper Niagara River, about five miles above the falls, to the lower river, developing power at Lewiston, where about 220 ft. head is available, with a second station at the lower river, where there is 100 ft. head available. The entire canal canal is to be about 10 miles in length.

INDUSTRIAL NOTES.

THE OHIO STEEL CO., of Youngstown, O., will put in a rail mill with a capacity of 800 to 1,200 tons per day.

DUMP CARS.—The Dunellen Phosphate Co., of Rockwell, Fla., will purchase a number of 3-ft. gage side dump cars of 2½ cu. yds. capacity.

THE MADISON CAR WORKS, of Madison, Ill., are reported as intended to be reopened shortly, after having been shut down since last summer.

THE RODGER BALLAST CAR CO., of Chicago, has delivered a train of 20 ballast cars and a ballast plow to the St. Louis, Keokuk & Northwestern R. R.

THE CONSOLIDATED CAR HEATING CO. states that its commingler system of heating has been applied on the transcontinental trains of the Canadian Pacific Ry.

THE HALL SIGNAL CO., New York, N. Y., has the contract to equip the Morris & Essex Division of the Delaware, Lackawanna & Western R. R. with its automatic block signals, using the rail circuit.

THE PITTSBURG BRIDGE CO., Pittsburg, Pa., has received an order for the steel roof trusses, columns and girders for the new building of the Standard Mfg. Co., in Allegheny. The contract embraces about 250 tons. The company is also building a steel boiler house for one of the plants of the U. S. Glass Co.

THE AMERICAN TUBE & IRON CO., of Middletown, Pa., has a contract from the Ontario Natural Gas Co., of Kingsville, Ont., for 40 miles of 8-in. pipe, five miles of 6-in., ten miles of 4-in. and ten miles of 3-in. pipe. The pipe will be made at Middletown, Pa., and Youngstown, O. The contract is said to amount to about $175,000.

COAL CARS.—The Delaware, Susquehanna & Schuylkill R. R. has placed orders as follows for 1,000 hopper bottom coal cars of 60,000 lbs. capacity, fitted with Westinghouse brakes and M. C. B. couplers: Murray, MacDougall & Co., Milton, Pa., 450 cars; Carlisle Mfg. Co., Carlisle, Pa., 200; Lebanon Mfg. Co., Lebanon, Pa., 175; Jackson & Woodin Mfg. Co., Berwick, Pa., 175.

THE GENERAL MFG. CO. is the title of a corporation recently organized in New Jersey. The authorized capital is $2,500,000, and it is proposed to build large works at Bound Brook, N. J., as soon as possible. One department will be devoted to the manufacture of graphite bearings, another to water-works and hydraulic machinery; the latter will be superintended by Mr. Ernest W. Nayloe, M. Am. Soc. M. E. The offices are in the Havemeyer Building, New York city. Pres., Abner W. Pollard; Vice-Pres., Robert S. O. Laughlin; Treas., Louis A. Pollard; Secy., Ed. G. Kidder; Bus. Man., J. B. Cleaver.

NEW COMPANIES.—Bates Conveyor Co., Chicago, Ill.: $100,000; A. F. Carr, R. N. Fowler and C. H. Glendenning.——Florence Improvement Co., Florence, Colo.: $400,000; W. E. Johnson, W. H. Huff and H. A. Woodworth.——Missouri, Kansas & Colorado Coal Mining Co., Kansas City, Kan.: $1,000,000; T. J. Enright, Argenting, Kan.; J. F. Allen, Aspen, Colo.; H. P. Ismert, Kansas City, Kan.

METAL MARKET PRICES.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; girder rails, $28; old rails, $11.75 to $12 for iron and $9 to $9.50 for steel. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $11 for iron and $6.75 for steel.

TRACK MATERIAL.—New York: angle bars, 1.3 to 1.4 cts.; spikes, 1.7 to 1.9 cts.; track bolts, 2.2 to 2.4 cts. with square and 2.3 to 2.5 cts. with hexagon nuts. Chicago: angle bars, 1.4 cts.; spikes, 1.8 to 1.85 cts.; track bolts, 2.45 to 2.5 cts. with hexagon nuts.

FOUNDRY PIG IRON.—New York: $12 to $14. Pittsburg: $10.75 to $12. Chicago: $11.75 to $13.

LEAD.—New York: 3.2 to 3.3 cts. Chicago, 3.15 cts.

NAILS.—Pittsburg: $1.10 to $1.15 for wire and $1 to $1.05 cts. for cut at mill.

STRUCTURAL MATERIAL.—New York: beams, 1.5 to 2.25 cts.; channels, 1.5 to 2 cts.; angles, 1.4 to 1.6 cts.; tees, 1.7 to 2 cts.; universal mill plates, 1.4 to 1.65 cts.; steel plates, 1.35 to 1.55 cts. for tank, 1.55 to 1.65 cts. for shell, 1.75 to 2 cts. for flange, 2 to 2.5 cts. for firebox. Pittsburg: beams, 1.25 to 1.35 cts.; channels, 1.25 to 1.35 cts.; angles, 1.25 to 1.3 cts.; tees, 1.4 to 1.5 cts.; universal mill plates, 1.25 to 1.3 cts.; steel plates, 1.25 to 1.3 cts. for tank, 1.4 to 1.5 cts. for shell, 1.5 to 1.6 cts. for flange, 1.75 cts. for ordinary firebox and 2 cts. for railway firebox. Chicago: beams, 1.45 to 1.5 cts.; channels, 1.45 to 1.5 cts.; angles, 1.4 to 1.45 cts.; tees, 1.75 to 1.8 cts.; universal plates, 1.5 to 1.6 cts.; steel plates, 1.5 to 1.6 cts. for tank, 1.7 to 1.8 cts. for shell, 1.9 to 2 cts. for flange, 2.75 to 5 cts. for firebox.

ELECTRIC LIGHTING, PADUCAH, KY.

Sealed proposals will be received by the City Clerk until March 15 for lighting the City of Paducah, Ky., with 100 electric arc lights for five or ten years. 7-2t

U. S. ENGINEER OFFICE.—Wilmington N. C., February 10th, 1894.—SEALED PROPOSALS for dredging in the Inland Waterway between Beaufort Harbor and New River, North Carolina, will be received at this office until 11 a. m., Saturday, March 10th, 1894, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office.—W. S. STANTON, Major Corps of Engineers, U. S. A. 7-4t

U. S. ENGINEER OFFICE.—Wilmington, N. C., February 10th, 1894.—SEALED PROPOSALS for dredging at Shad Island Bend, Roanoke River, N. C., will be received at this office until 11 a. m., Saturday, March 10th, 1894, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office.—W. S. STANTON, Major Corps of Engineers, U. S. A. 7-4t

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., February 1st, 1894.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 27th day of February, 1894, and opened immediately thereafter, for all the labor and materials required for the interior finish, plumbing and approaches for the U. S. Post-Office building at Fremont, Nebraska, in accordance with the drawings and specification, copies of which may be had at this office, or the office of the Superintendent at Fremont, Nebraska. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any and all bids and to waive any defect or informality in any bid if it be deemed in the interest of the government to do so. All bids received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for the Interior Finish, etc., of the U. S. Post-Office Building at Fremont, Nebraska," and addressed to JEREMIAH O'ROURKE, Supervising Architect. 6-2t

GREENFIELD WATER-WORKS.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the city of Greenfield, Ind., up to 8 p. m. of March 21, 1894, for furnishing the materials and constructing a system of water-works for said city.

There will be required about 452 tons of cast iron pipe, 13 tons of special castings, 60 fire hydrants, brick pumping station and chimney, two pumps of combined capacity of two million gallons per day, pump well, the necessary valves, valve-boxes, etc.

Bids will be received for furnishing materials above or for constructing the works complete. Proposals must be addressed to the City Clerk, and must contain a certified check or its equivalent, made payable to the City Treasurer of Greenfield, Ind., in an amount equal to two (2) per cent. of the amount of the bid.

Plans may be seen and specifications and blank form of proposal procured at the office of the City Clerk, Greenfield, Ind., or at the office of the engineers, Voorhees & Witmer, rooms 65 and 66 Chapin Block, Buffalo, N. Y.

The right is reserved to reject any and all bids.

AMBROSE J. HERRON, Mayor.
HARRY G. STRICKLAND, Clerk. 7-1t

TENDERS FOR PUMPING ENGINES FOR THE WINNIPEG WATER-WORKS COMPANY, WINNIPEG, MAN.

Sealed proposals will be received by the Winnipeg Water-Works Company, at Winnipeg, at their office in the said city up to 3 o'clock p. m. of March 10, 1894, for the construction and erection complete, in readiness for operation upon a suitable foundation to be provided by the water company in a building to be erected for the purpose at the present pumping station of the water-works, of a Vertical Flywheel Pumping Engine, capable of safely, regularly and economically forcing two million gallons of water per day from the level of Assiniboine River against a pressure of sixty (60) pounds, with a suction lift of not over twenty (20) feet.

Specifications may be obtained on application to the company, at Winnipeg, Manitoba.

7-4t E. H. BISSETT, Mgr.

PROPOSALS FOR SEWERS.

Sealed proposals will be received by the Board of Councilmen of the City of Newport, Ky., at the Council Chamber, Thursday evening, Feb. 22, 1894, until 8 o'clock, for the construction of sewers in Sewerage Districts B, C and D. The work comprises about 5 miles of pipe sewers, 73 catch basins, 170 manholes, 27 flush tanks, stone masonry, piling, etc., etc.

The work to be done in accordance with plans and specifications on file in the office of the City Engineer, where blank forms of proposal and contract may be had.

The right to reject any or all bids is reserved.

B. R. MORTON, City Engineer.
Newport, Ky., Feb. 9, 1894. 7-1t